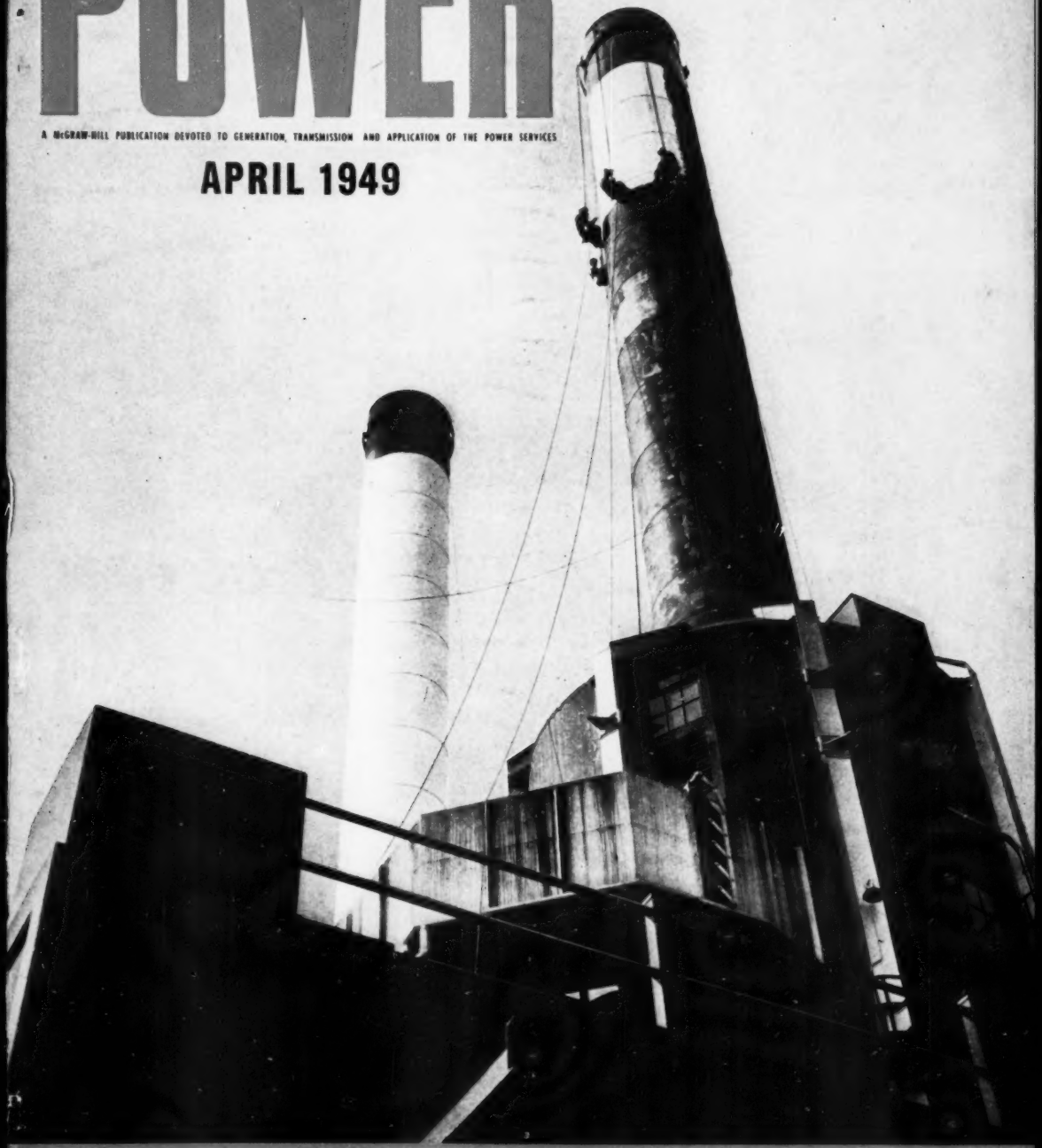
POWER

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

APRIL 1949



IN THIS ISSUE:

A 16-page special section—

FLEXIBLE COUPLINGS

WHAT'S *Loop-the-Loop*
GOT TO DO WITH ASH HANDLING

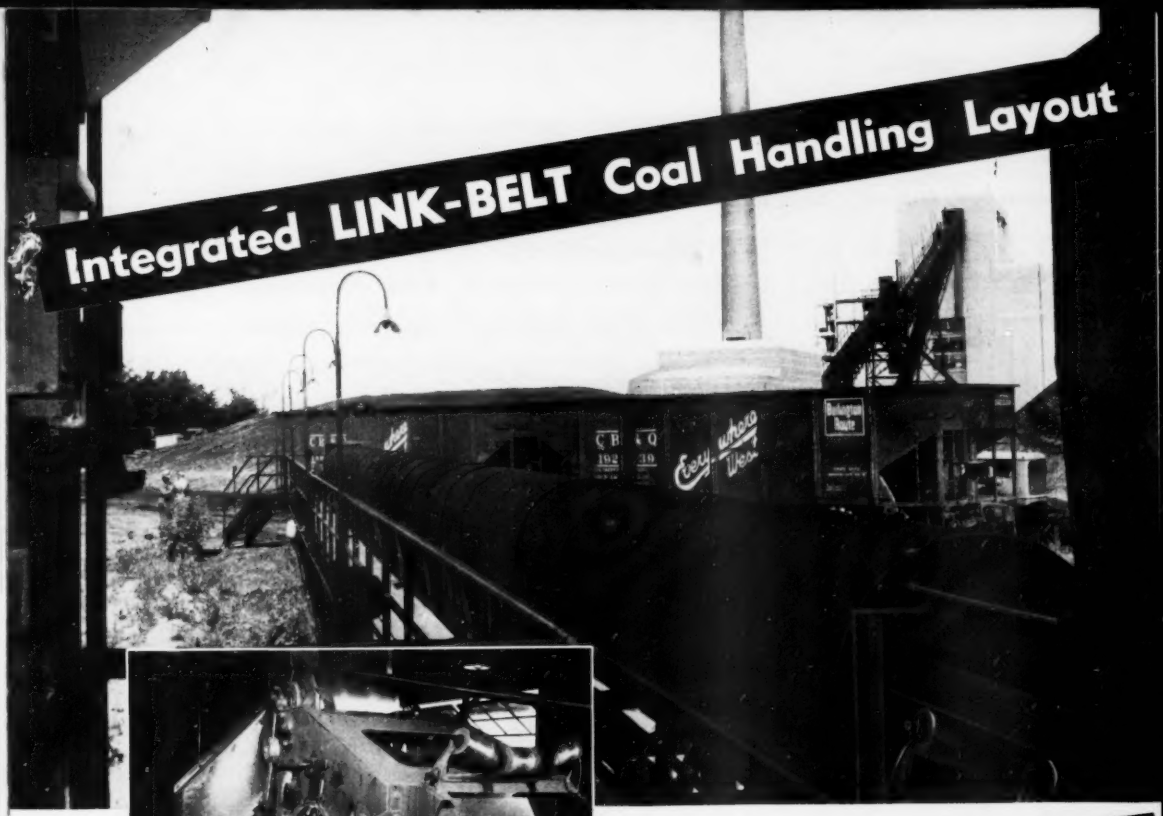
Just this . . . the water in a Recirculating Hydrojet System does the same thing . . . comes back to its starting point, with no loss out of the system. In fact, a small amount of water to replace that absorbed by the ashes must be added. None whatever goes to sewer or waste . . . consequently, no such thing as stream or harbor pollution is possible with a Recirculating Hydrojet System. There will be dust too. We take care of this with the Automatic Hydrovac System that uses the same high pressure water which is also recirculated. Our nearest representative will gladly give you the details. Write us.

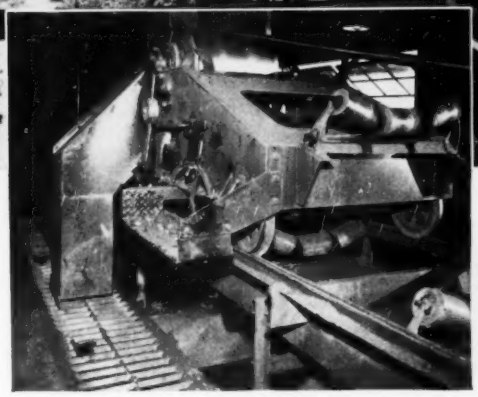
HYDROJET *Ash Handling*

ALLEN-SHERMAN-HOFF CO., 227 S. 15th ST., PHILADELPHIA 2, PA. ***Offices & Representatives in Principal Cities***

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," "The Stationary Engineer"), April, 1949, Vol. 93, No. 4. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 W. 42nd St., New York 18, N. Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least 10 days for change of address. Subscription rates, U. S. and U. S. possessions, $5 for one year, $7 for two years, 50c per single copy. Canada, $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.

Integrated LINK-BELT Coal Handling Layout





at Interstate Power Co. Clinton, Iowa

Four-way flexibility, along with rock-bottom handling costs, is provided by the coal conveyor system installed by Link-Belt at the Interstate Power Company at Clinton, Iowa.

Integrated from standardized types of equipment, this layout receives coal from either railroad cars or from river barges and delivers it to ground storage or to boiler room bunkers as desired. The system also reclaims coal from ground storage to conveyor in connection with a scraper.

This equipment consists of reciprocating feeders, belt conveyors and a self-propelled traveling tripper for distributing coal to the bunkers. A feature of this installation is the use of hood-type corrugated metal housing for the belt conveyors.

Hardly ever are two handling jobs the same. But whatever the job calls for, Link-Belt has the experience to design the layout and the equipment to make the most satisfactory operation. Let us discuss your problem with you.

11,293

TYPES OF LINK-BELT CONVEYING MACHINERY

Belt Conveyors	Chain Conveyors	Oscillating Conveyors
Screw Conveyors	Trolley Conveyors	Flight Conveyors
Bulk-Flo Conveyors	Apron Conveyors	Bucket Elevators
		Bucket Carriers

LINK-BELT COMPANY Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

LINK-BELT

CONVEYING MACHINERY
"THE COMPLETE LINE"

Alabama Pulp & Paper Co. Allied Chemical & Dye Corp. National Aniline Div. **Solvay Process Div. Altos Hornos de Mexico

Ash Grove Lime & Portland Cement Co. Atlantic Refining Co. Atlantic Seaboard Corp. Bahrein Petroleum Co., Ltd. Bird & Son, I

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Service Board (San Antonio, Texas) *City Public Service Co. (Lordsburg, N. M.) Compania Ferrocarrilera de Petroleo (Argentin

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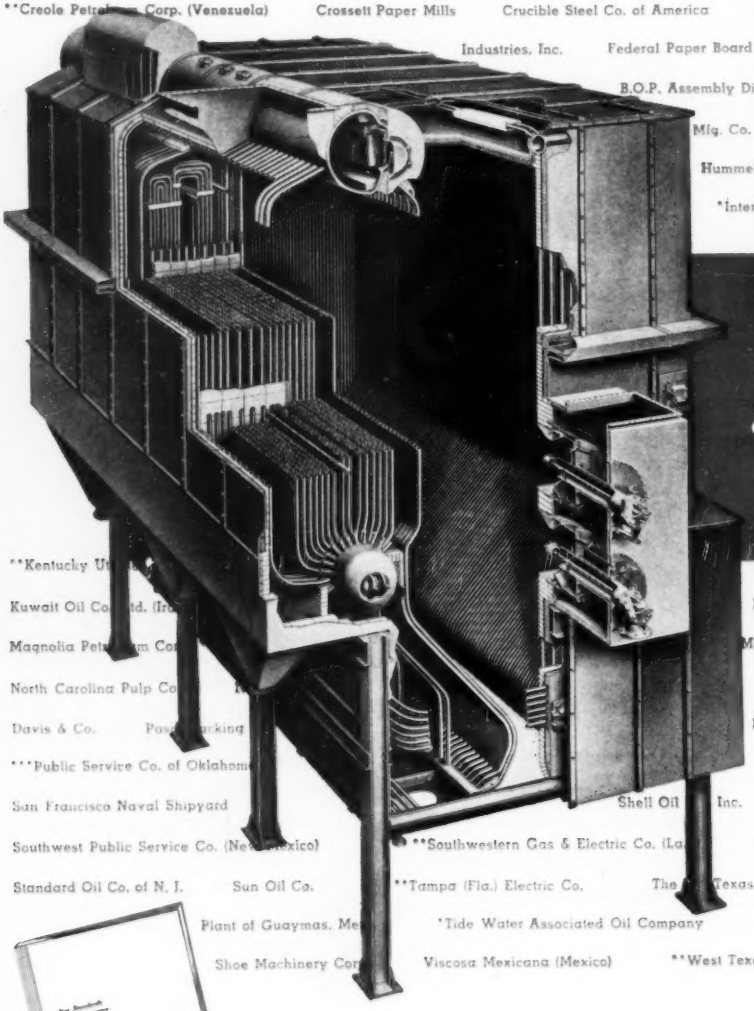
*International Paper Co. Interstate Power C



...making

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Kuwait Oil Co. Ltd. (Ir

Magnolia Pet m Co

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Davis & Co. Pos arking

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Southwestern Public Service Co. (Texas)

**Tampa (Fla.) Electric Co. The Texas Co. Texas Power & Light Co. Textil

*Tide Water Associated Oil Company Tucson (Ariz.) Gas & Electric Co.

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Worth looking into NOW
for low-cost steam TOMORROW

Send for Bulletin G-38 describing and illustrating features and showing typical applications of the Type FH boiler.

American Cyanamid Co.—Calco Chemical Div. American Enka Corp. American Potash & Chemical Corp. American Tobacco Co.

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In meeting new needs for steam for power generation, heating and processing purposes, a fast-growing number of industries and power companies are finding the ideal answer to their requirements up to 300,000 lb. per hr. in the • • •

friends *fast!*

TYPE FH INTEGRAL-FURNACE BOILER

Loup River Power District Madison (Wisc.) Gas & Light

Newport News Shipbuilding & Dry Dock Co.

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Co. Wood Conversion Co. *Wyandotte Chemical Corp.

*Repeat orders to date.

An important advance in steam engineering, this latest B&W unit brings together in a modern standardized design all the best features of the original and highly successful Integral Furnace Boiler introduced by B&W 14 years ago, plus many additional improvements . . . each one time-tested and performance-proved in other types of B&W units.

Immediate and widespread acceptance—over 35 million pounds per hr. of steam capacity installed or ordered in less than 4 years—is evidence that the type FH Boiler satisfies all modern requirements for dependability, efficiency, accessibility, flexibility, and economy of installation and operation.

The advantages of standardization are made available in three general classes of Type FH Boilers which provide the variations in furnace size and arrangement of heating surface necessary for reasonable latitude of application. The available range covers pressures up to 1050 psi and temperatures to 910 F.

It will pay you, as it has so many others, to consult B&W engineers about this boiler when planning a new power or modernizing present power facilities.

THE BABCOCK & WILCOX CO.

General Offices: 85 Liberty Street, New York 6, N. Y. Works: Alliance and Barberton, O.; Augusta, Ga.

FOR POWER PLANTS—B&W Open-Pass, Radiant, Integral-Furnace, Cross-Drum, Stirling and Waste-Heat Stationary Boilers . . . Air Heaters . . . Economizers . . . Superheaters . . . Water-Cooled Furnaces . . . Oil, Gas & Multifuel Burners . . . Chain-Grate Stokers . . . Stacks and Breechings . . . Seamless & Welded Tubes for All Pressure and Mechanical Applications . . . Refractories . . . Chemical Recovery Units . . . Alloy Castings.

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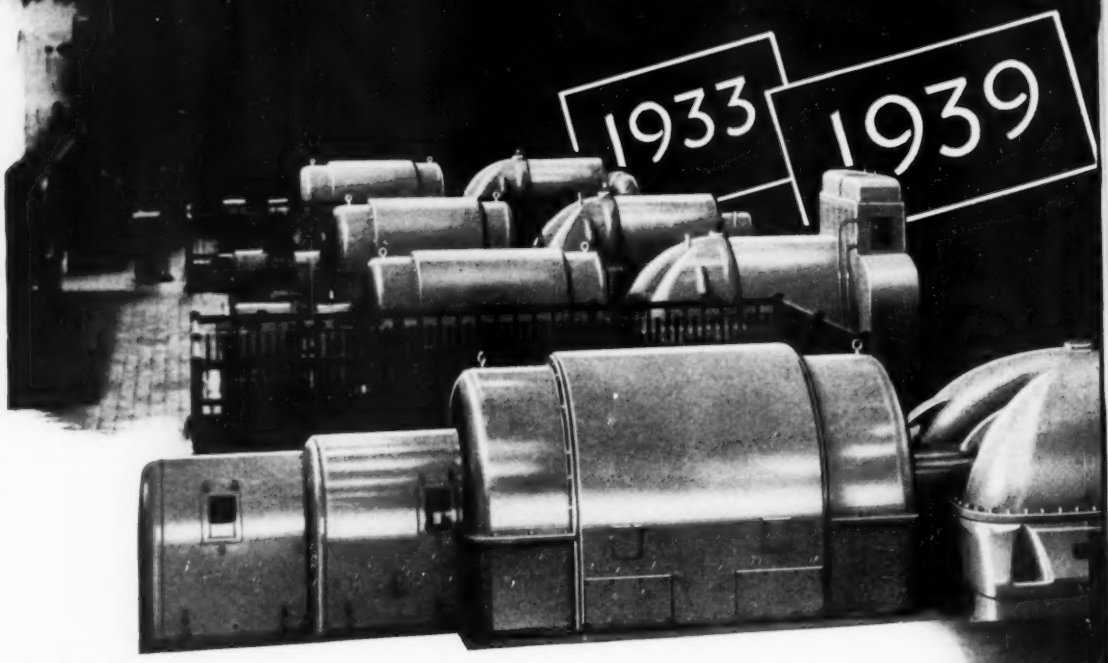
OTHER B&W PRODUCTS—Marine Boilers . . . Pressure Vessels . . . Process Equipment.

G-426

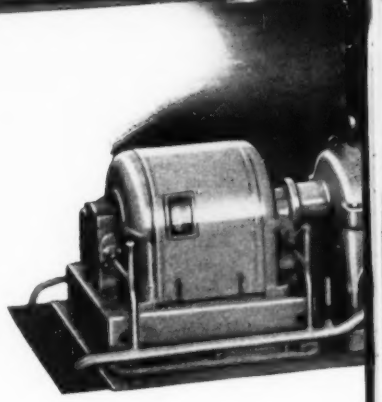
BABCOCK & WILCOX

Because they keep



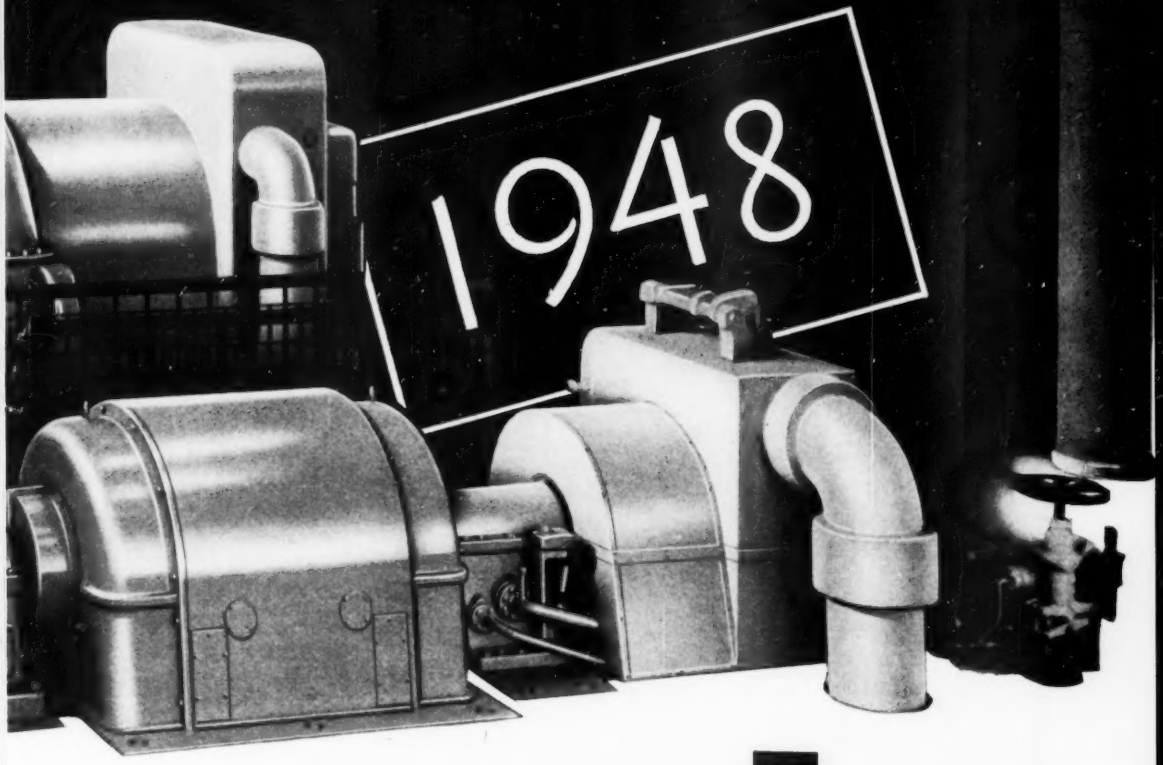
CONFIDENCE like history, repeats itself — when it is soundly based. In this Ohio utility plant, the first two Elliott 4000-kw turbine-generators, installed in 1933, definitely made good. On the basis of their performance, another 4000-kw Elliott unit was installed in 1939. And now, in 1948, two more units are bringing the power output up to the 24-hour per day demands of a thriving and growing industrial community.

The latest installations are a 7500-kw unit, served by an Elliott condenser, and a 1000-kw noncondensing unit, which was installed to supply industrial process steam, or for use as a station house turbine. The entire installation is one of which any manufacturer could be proud.



Elliott

on making good



H-718

COMPANY

Steam Turbine Dept.

JEANNETTE, PA.

Plants at: JEANNETTE, PA. • RIDGWAY, PA
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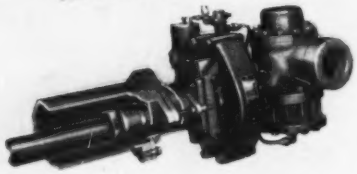
DISTRICT OFFICES IN PRINCIPAL CITIES

STEAM TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES
EXPANDERS • TUBE CLEANERS • STRAINERS • FILTERS

THE UPWARD TREND

DIAMOND LEADERSHIP CONTINUES IN THE TREND TO AUTOMATIC OPERATION

DIAMOND Model A2E Automatic Air Puff Soot Blower



Automatically cleans heating surfaces by series of compressed air puffs delivered through permanently installed multiple nozzle blowing element.

DIAMOND Model G9B Soot Blower

Uses steam as cleaning medium through permanently installed multiple nozzle blowing element. Operation is manual, air (shown) or electric.

DIAMOND Model I5 Short Retracting Soot Blower

Uses either air or steam as cleaning medium. Operation is manual, air (shown) or electric.

Manually operated Diamond Soot Blowers can be converted to automatic operation; they can also be made sequential in operation by the addition of a control panel.

DIAMOND Model IK Long Retracting Soot Blower

Cleaning medium is either air or steam. Air operation shown; electric operation also available.

DIAMOND Telescopic Long Retracting Soot Blower

Uses air or steam as cleaning medium. Operation is either air or electric (shown).

CONTINUES . . .

MORE AUTOMATIC SOOT BLOWERS in Central Stations

52% of the DIAMOND SOOT BLOWERS sold to Central Stations during 1948 were for AUTOMATIC OPERATION

Central Stations, where the need for equipment of maximum economy and effectiveness is most keenly felt, show an increasing preference for soot blowers with automatic sequential operation. Our records indicate that 52% of the Diamond Soot Blowers sold to Central Stations in 1948 were automatic in operation . . . a significant increase over any previous year.

This marked trend to automatic sequential operation is a logical outcome of the many advantages offered by Diamond Automatic Soot Blowers over those having manual operation. Among these advantages are: (1) thorough cleaning is always assured . . . no blowers can be forgotten or operated in a careless or incorrect manner, (2) labor is saved . . . blowers do not have to be tended individually, (3) some saving of energy from the coal pile, and (4) remote operation from the boiler control panel or other convenient point.

Diamond pioneered automatic soot blowing . . . with both air and steam as the cleaning medium. Diamond installed the first automatically operated soot blowers in 1921. The continuous research, development and application engineering that Diamond has carried on since that time have resulted in a leadership and "know how" that is unapproached in this field. For the correct answer to your soot blowing problems, consult Diamond.

3851

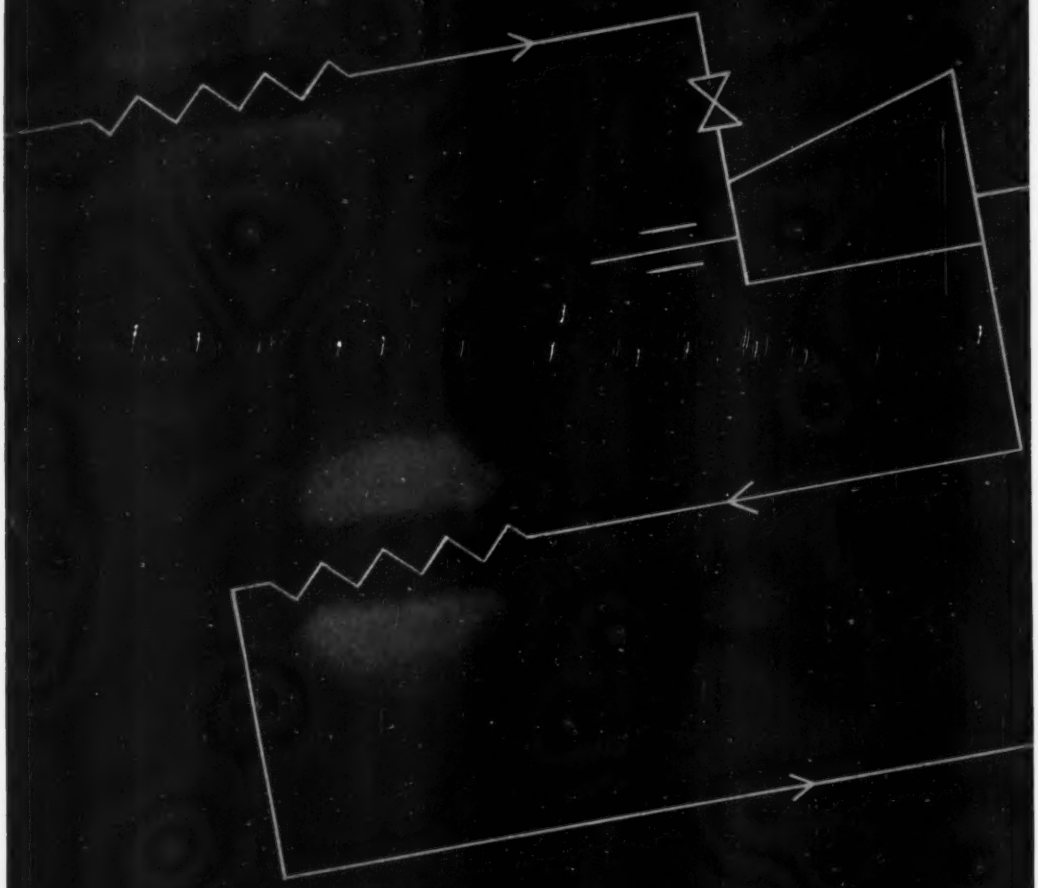
DIAMOND POWER SPECIALTY CORP.
DETROIT 31, MICHIGAN
Diamond Specialty Limited • Windsor, Ontario

WRITE FOR BULLETIN 1014
It illustrates and describes the varied line of Diamond Soot Blowers . . . shows how they meet differing needs.

steam generation – *an art*

RADIANT SUPERHEATERS AND RADIANT REHEATERS

...engineered and fabricated by Foster Wheeler, helped one midwest station earn the reputation for being the country's most efficient steam power plant.



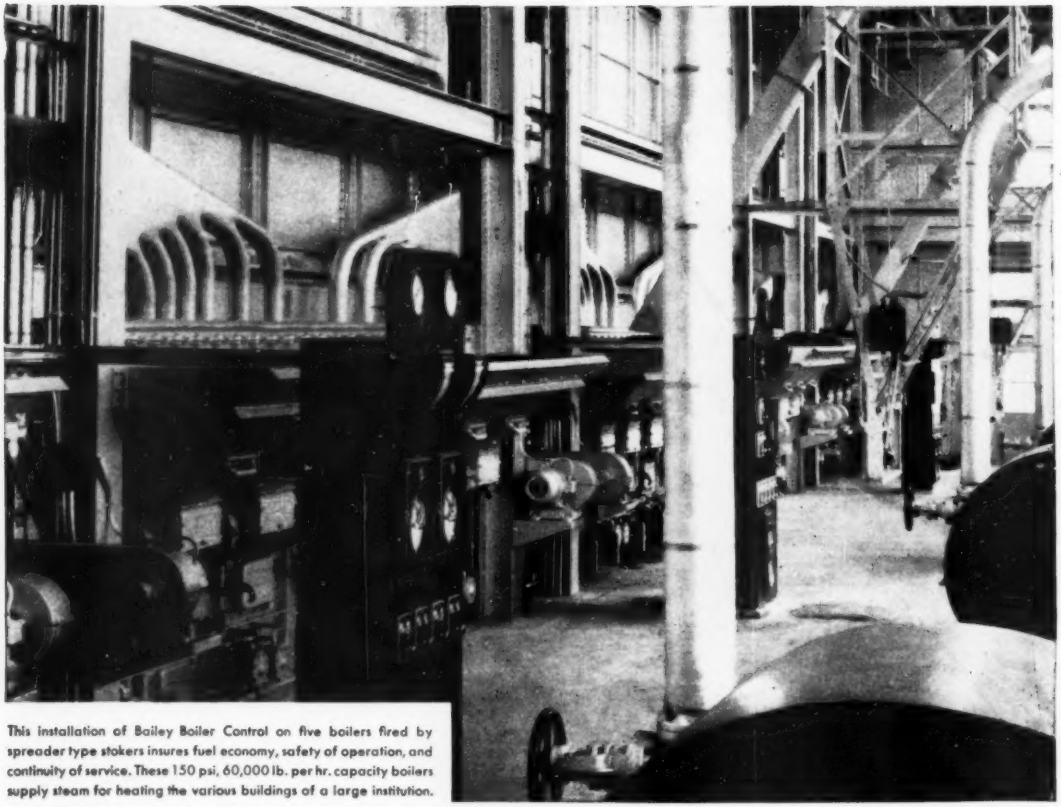
The Foster Wheeler organization has devoted over fifty years to improving steam generation technique and steam power plant equipment. A few of FW's historical achievements are listed below:

- [illegible] Pulverized fuel was developed on a commercially successful scale.
- 1922 Superheated steam was introduced commercially in the United States.
- 1931 Radiant superheaters were developed after long research and development.
- 1934 Water walls and water backs were applied to many types of furnaces burning various fuels.
- 1948 The first large steam generator in a utility plant to operate at 1000° F over a wide load range was installed.
- TODAY All the engineering, manufacturing, and construction activities of the Foster Wheeler organization are geared toward helping build the better power plants of today and tomorrow.

FOSTER WHEELER CORPORATION · 165 BROADWAY, N.Y. 6, N.Y.

FOSTER WHEELER

Loafing Btu's produce no



This installation of Bailey Boiler Control on five boilers fired by spreader type stokers insures fuel economy, safety of operation, and continuity of service. These 150 psi, 60,000 lb. per hr. capacity boilers supply steam for heating the various buildings of a large institution.

Branches in: Boston, New York, Schenectady, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Cincinnati, Atlanta, Chicago, Milwaukee, St. Louis,

power

You find loafers everywhere. Even in a collection of Btu's. You have to *make* them work if you expect to get low cost power. And that is exactly what the Bailey co-ordinated boiler control system is designed to do.

It reduces fuel consumption per pound of steam generated. Combustion, feed water, steam temperature, heater levels, pump speeds and other factors are co-ordinated. Safety of operation is increased—continuity of service is improved. You convert the maximum number of Btu's into power and get all the efficiency your boiler was designed to deliver.

One thing to remember, however, is the fact that this Bailey system is **not** delivered in a standard package. Each one is designed and engineered to the specific job on which it is to be used. That's *why* it functions so efficiently.

If you are looking for low cost power, it will pay you to call our nearest office.

BAILEY METER COMPANY
1036 IVANHOE ROAD · CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

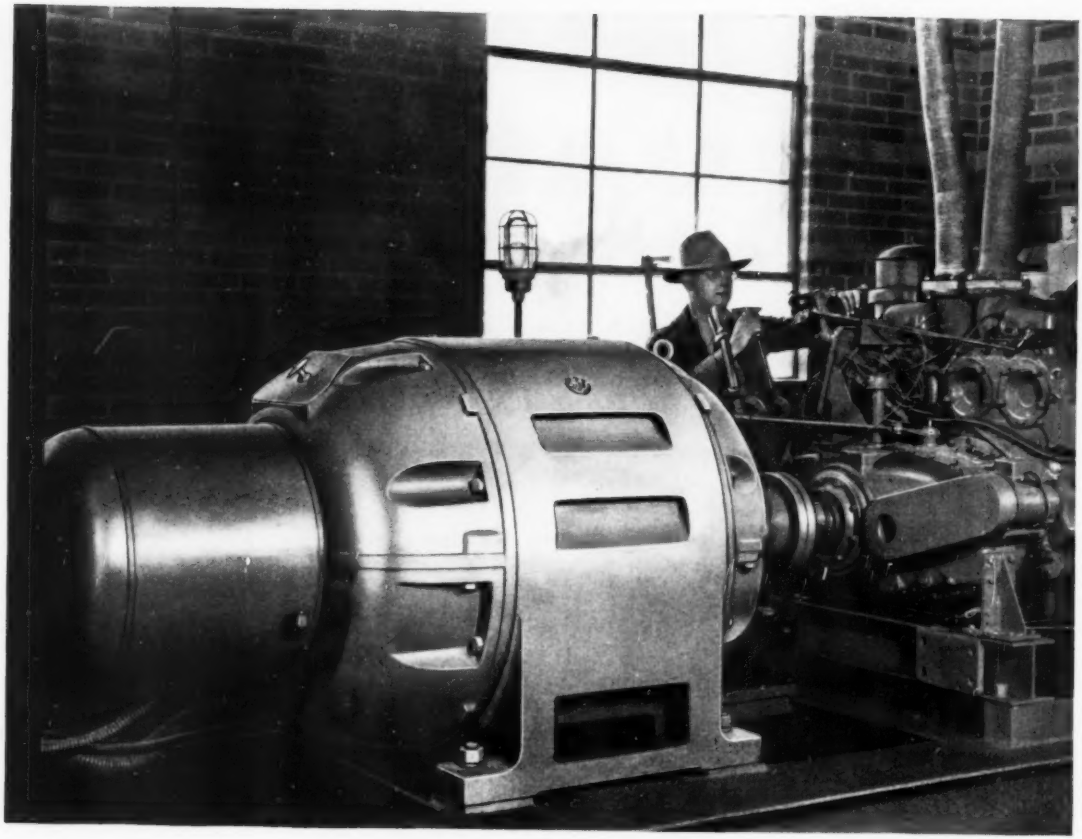
Controls for Steam Plants

COMBUSTION · FEED WATER · TEMPERATURE
PRESSURE · LIQUID LEVEL · FEED PUMPS

A-104-2

New Orleans, St. Paul, Kansas City, Houston, Denver, Los Angeles, Seattle, San Francisco • Halifax, Montreal, Toronto, Winnepeg, Vancouver

for Appearance



for Compactness

Beaumont Buys General Electric TRI CLAD Synchronous Generators

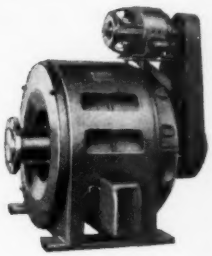
The City of Beaumont, Texas, had a problem when they installed a standby power plant for their water plant. A diesel-driven generator was chosen for efficiency and operating economy. But the new plant had to be compact—it was installed in an existing building with no special foundations and low headroom. The plant had to operate dependably with a minimum of attention and maintenance.

Electrically, the Tri-Clad high-speed synchronous generator gave all the right answers. Smooth contours and a compact frame are external evidence of a complete redesign. Tri-Clad high-speed synchronous generators incorporate the convenience and protection features of the industry-proved Tri-Clad induction motors. You get extra protection and convenience plus smooth, attractive appearance when you couple Tri-Clad high-speed synchronous generators to your diesels.

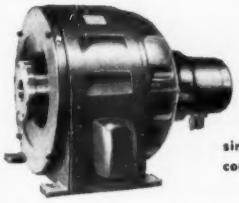
Contact your nearest G-E sales representative for more information. Ask him about ratings, modifications, and shipment. You can get the generator you need quickly. ***Apparatus Dept., General Electric Co., Schenectady 5, N. Y.***

YOU GET VERSATILITY, TOO! There are modifications to fit every requirement:

standard generator for direct-coupling, belt- or chain-drive



top-mounted exciters



single-bearing direct-coupled generator

GENERAL ELECTRIC

Apparatus Dept., Sec. C770-3
General Electric Company
1 River Road
Schenectady 5, N. Y.

Gentlemen:

Please send me a copy of GEA-5125 that gives me more information on Tri-Clad high-speed synchronous generators.

Name.....

Company.....

Street.....

City..... State.....

BOILER CONTROLS • INSTRUMENTS • PROCESS CONTROLS

The Republic Flow Meters Co. offers a complete manufacturing and engineering service in the field of measurement and control. We will be glad to co-operate with you in the solution of any metering or control problem, whether it involves a single instrument or the automatic control of an entire process or plant.

Republic engineers, in co-operation with your own engineers, will be glad to study your problem and make recommendations as to the most practical solution. Your inquiries will involve no obligation on your part.

BOILER CONTROLS

For All Types of Boilers

Republic offers a centralized, automatic system for controlling steam pressure, combustion, furnace pressure, excess pressure, boiler water level, etc.

Automatically regulates the fuel and air imput to a boiler in measured proportions and in a fixed ratio for the entire load range. Available for all sizes of boilers and all types of fuel firing.

FLOW METERS

Electrical and Mechanical

Republic electrical type remote reading flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for line pressures up to 10,000 p. s. i. and for all ranges of differential pressures.

Mechanical ring-balance meters are built for static pressures up to 2500 p.s.i. and to operate on differentials as low as 3 in. of water.

BOILER METERS

Record Steam Flow—Air Flow

The Republic boiler meter records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion.

The air flow pen is adjusted to record coincident with the steam flow pen when the furnace is receiving the proper amount of air for maximum combustion efficiency.

PNEUMATIC TRANSMITTERS

For Measurement and Control

Republic pneumatic transmitters are devices for converting process variables, such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables.

These air pressures can be used as the measuring impulse for the actuation of an automatic controller or a direct reading recorder.

REPUBLIC FLOW METERS CO.

WRITE FOR YOUR COPY of Our Condensed Catalog on Instruments and Controls

VALVES

Regulating—Pressure Reducing

All Republic valves are engineered to the specific job on which they are used. Cylinder operated valves are available in sizes from 3 in. to 24 in. Hand operated valves in sizes from 1 in. to 8 in. Lever operated valves in sizes up to 16 in.

Republic valves are built in all pressure standards—both flanged and welded ends. Streamlined flow through parts virtually eliminates erosion.

REGULATORS

Pneumatic and Hydraulic

Republic pneumatic or hydraulic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, liquid level, or the proportioning of two pressures, flows, etc., in a fixed ratio.

They measure the quantities they control regardless of the application. They can be made sensitive to changes of less than 0.002 in. of water.

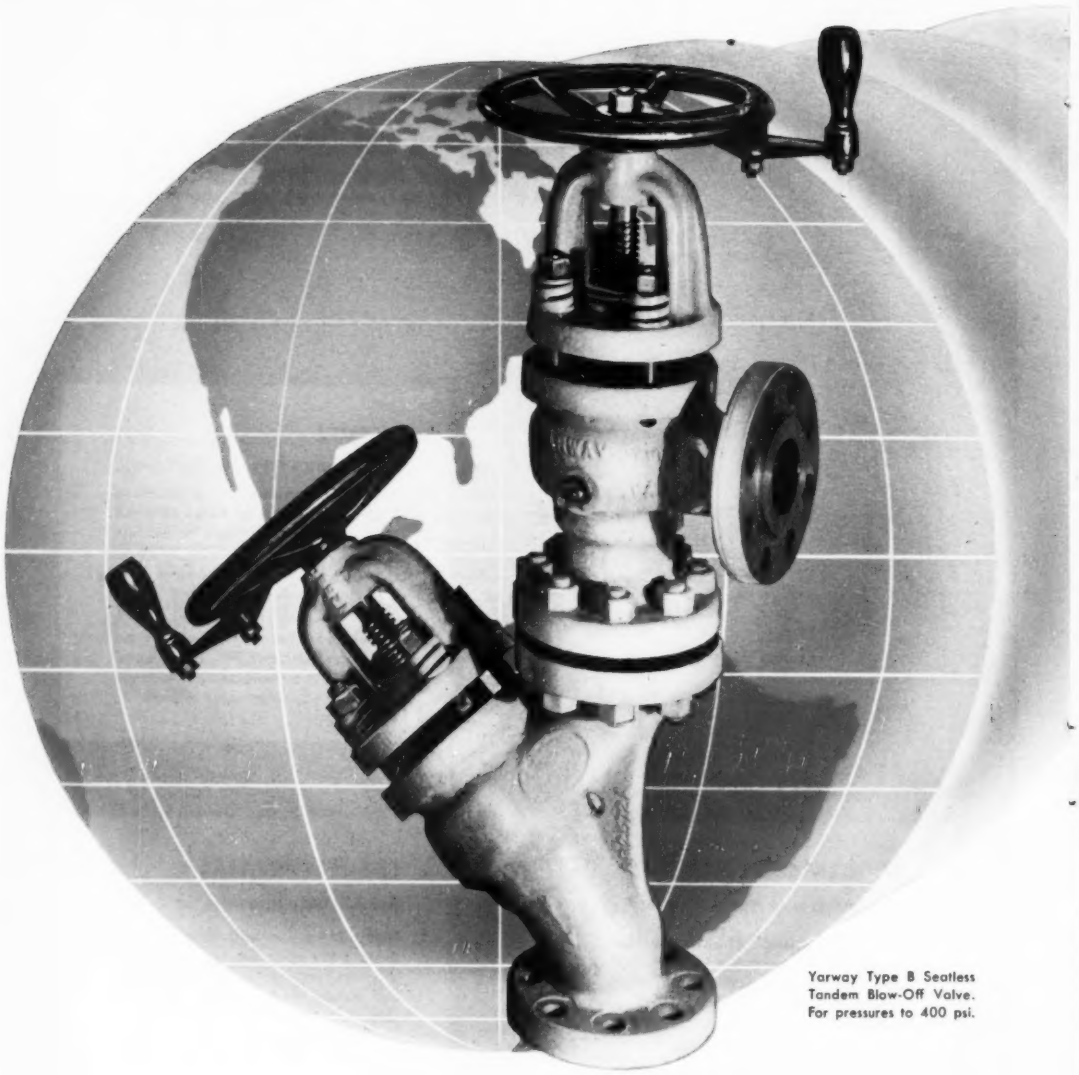
DESUPERHEATERS

For All Requirements

Republic desuperheaters are built to meet your specific requirements. Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with rugged, simply-controlled Republic desuperheaters.

These are of the venturi type with ratio control, the steam atomizing type and the mechanical atomizing type.

2240 Diversey Pkwy., Chicago 47, Illinois



Yarway Type B Seatless
Tandem Blow-Off Valve.
For pressures to 400 psi.

YARWAY

THEY KEEP BLOW-DOWN LINES TIGHT IN OVER 15,000 PLANTS

Yarway Blow-Off Valves are known in almost every plant where boilers are used to generate steam.

Why this thorough acceptance? Partly because the Yarway *Seatless* feature eliminates the commonest source of blow-off valve trouble. In Yarway *Seatless* Valves there are no seats to score, wear, clog and leak.

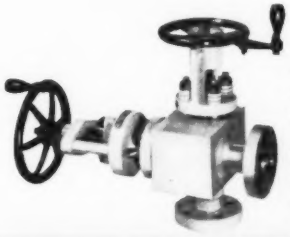
Partly because of Yarway's advanced designs—such as the Unit Tandem for high pressure work. This valve combines a Yarway *Stellite-Seat* Valve (for blowing) with a Yarway *Seatless* Valve (for sealing) in a solid, one piece forged-steel body.

And finally the dependable, trouble-free service of Yarway Blow-Off Valves prompts power plant engineers to insist on Yarways.

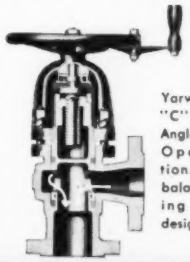
Regardless of the reason, the fact remains that today Yarway Valves are on the job—doing a good job—in more than 15,000 plants. How about yours?

Write for Bulletin B-424 for pressures to 400 psi. For higher pressures ask for B-432.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Penna.

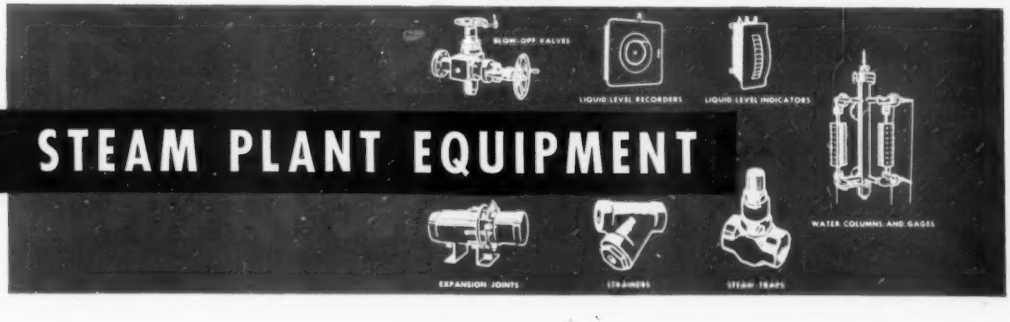


Yarway Unit Tandem Blow-Off Valve. Flanged type. Also available with welding ends. For pressures up to 2500 psi.



Yarway Type "C" Seatless Angle Valve. Open position. Notice balanced sliding plunger design.

Yarway Stellite-Seat Straightway Valve. Open Position.



Answering a reader's question on smoke and soot conditions, the BERGEN ENGINEER, official organ of the Bergen County Chapter (New Jersey) of the N.A.P.E., replied

> "... *Any stoker will burn any kind of coal after a fashion, but only coal of definite characteristics* EFFICIENTLY ..."

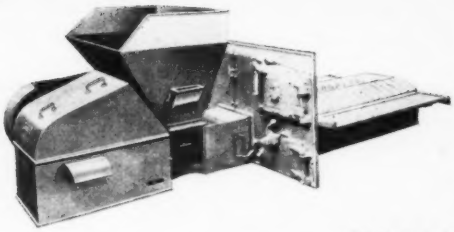
The coals that are available to *you* are the coals you are interested in. The stoker that will burn *those* coals efficiently is your natural requirement. And Combustion supplies that need with the most complete line of stokers available *anywhere*. Here you are free to choose, from all basic types, the stoker that exactly fits your three-way problem of fuel characteristics, load and operating conditions. No need to settle for a compromise that will burn your coal "after a fashion".

Getting the *right* stoker is more important than ever today as coal costs rise, for the cost of fuel burned soon far outweighs the original equipment cost. Careful selection of stokers means dividends in dollars as well as operating satisfaction. Let our engineers help you in this choice. More than 20,000 C-E stokers, serving all industries and burning every type of coal, provide an impressive background of experience. And Combustion's *complete* line assures you an unbiased recommendation ... the experienced judgment of a manufacturer that has no axe to grind.

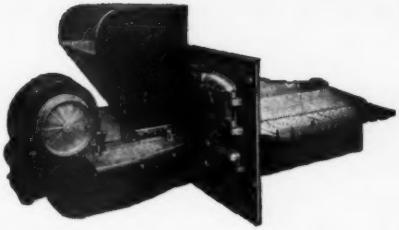
B-246-A

COMBUSTION ENGINEERING

A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY

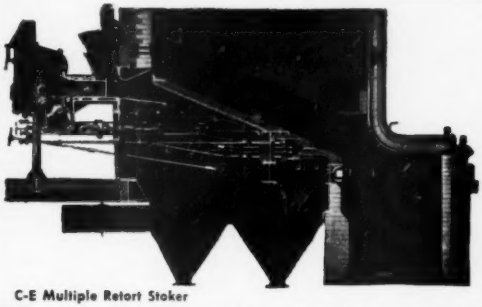


C-E Skelly Stoker

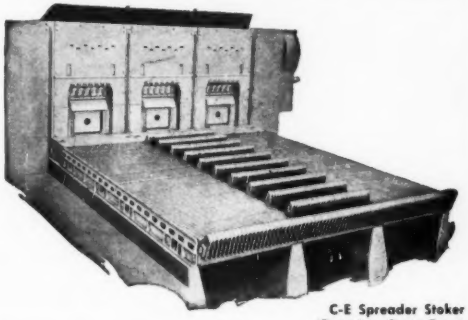


C-E Low Ram Stoker

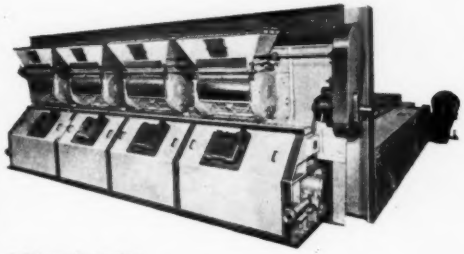
C-E Type E Stoker



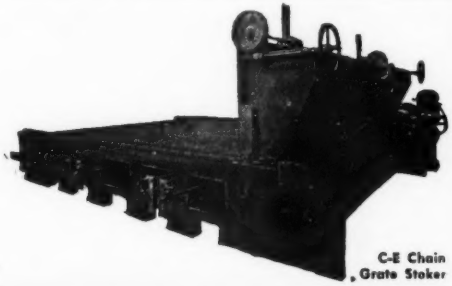
C-E Multiple Retort Stoker



C-E Spreader Stoker
(Dumping Grate Type)



C-E Spreader Stoker
(Continuous Discharge Type)



C-E Chain
Grate Stoker

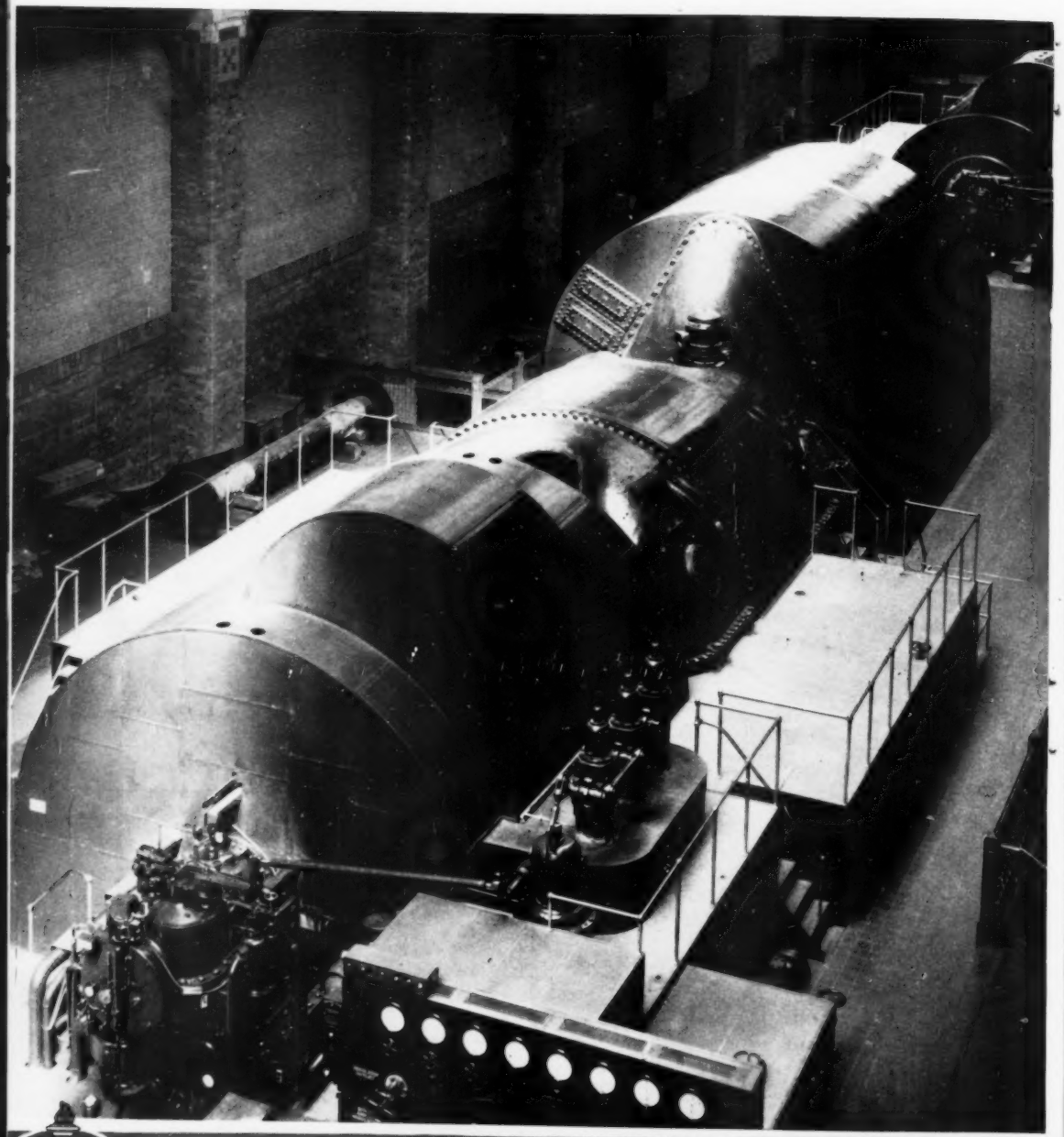
C-E Traveling Grate Stoker

—SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

160,000 KW... safeguarded against



STANDARD OIL COMPANY (INDIANA)

outages by

NONPAREIL
Turbine Oil

The two big turbines shown in the photograph at left have a total capacity of 160,000 KW. Outages for oil system maintenance have been eliminated on this large operation by Nonpareil Turbine Oil.

Oil acidity troubles have been avoided. The original fills of Nonpareil have not been removed for treating or resting in their respective five and six years of use. Nevertheless, neutralization numbers have stayed below 0.10 mg. KOH/gm.

Oil system maintenance has been eliminated. There has been no deterioration of the lubricant. The turbine oil systems have remained free from deposits.

Nonpareil Turbine Oil provides this protection against outages, not for 5 or 10 or 20 years, but for the life of every turbine it lubricates. It is the only product in its field that carries a written guarantee that it will last as long as your turbine, without increasing in acidity above a neutralization number of 0.15 mg. KOH/gm.

Why not end oil acidity troubles and oil maintenance once and for all, by shifting your turbines to Nonpareil Turbine Oil. If your plant is located in the Midwest, write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the services of the Standard Oil Lubrication Engineer nearest you.

STANDARD OIL COMPANY (INDIANA) STANDARD

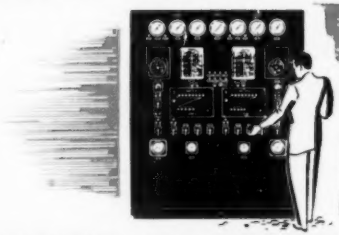
CITY OF BURBANK CALIFORNIA

WEST PENN POWER CO. PITTSBURGH, PA.

A few
Outstanding

VULCAN

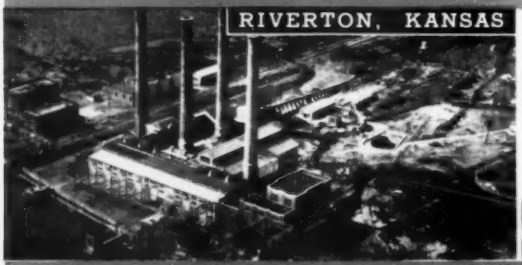
Automatic Sequential Soot Blower Installations in CENTRAL STATIONS



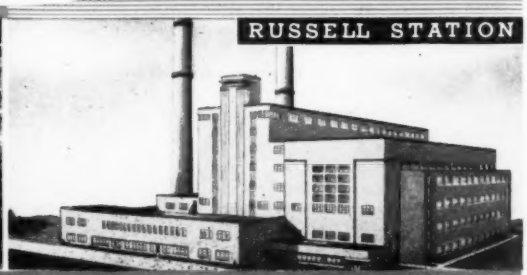
VULCAN SOOT BLOWER CORPORATION

DUBOIS, PENNA.

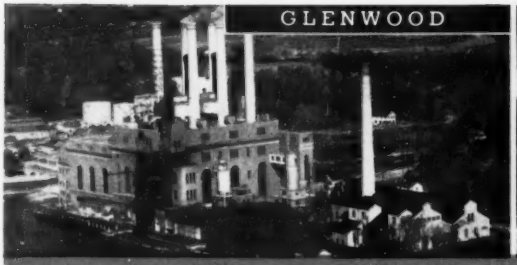
DIVISION OF CONTINENTAL FOUNDRY & MACHINE CO.



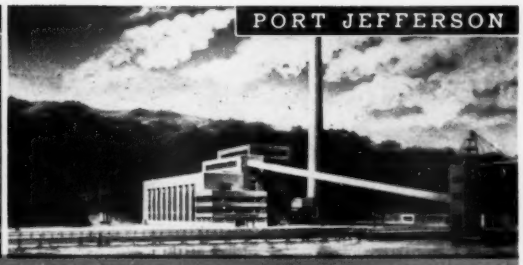
THE EMPIRE DISTRICT ELECTRIC CO.



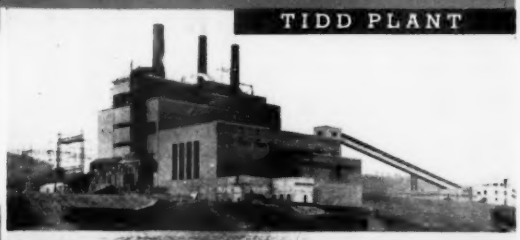
ROCHESTER GAS & ELECTRIC CORP.



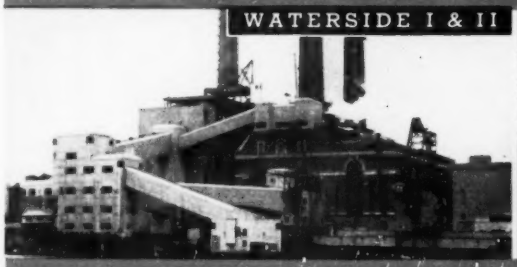
LONG ISLAND LIGHTING CO.



LONG ISLAND LIGHTING CO.



DESIGNED AND CONSTRUCTED UNDER SUPERVISION OF AMERICAN GAS & ELECTRIC SERVICE CORPORATION



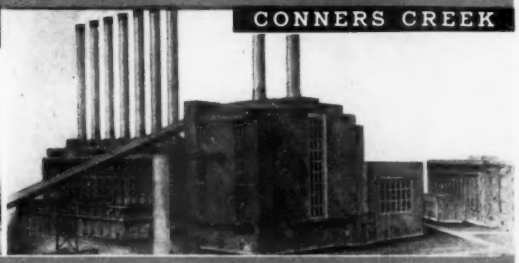
CONSOLIDATED EDISON CO. OF NEW YORK, INC.

THE CINCINNATI GAS & ELECTRIC CO.

PENNSYLVANIA POWER & LIGHT CO.

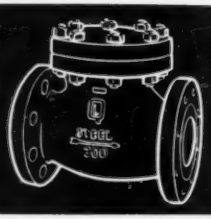
CONSOLIDATED EDISON CO. OF NEW YORK, INC.

PUBLIC SERVICE ELECTRIC & GAS CO.



DETROIT EDISON COMPANY

NEED CHECK VALVES?



...CHECK LUNKENHEIMER

BY the very nature of their service, check valves must be dependable. That Lunkenheimer Check Valves provide this kind of service is proved by innumerable installations, in plants large and small, throughout the nation.

Recognized by leading valve users as remarkably trouble-free, Lunkenheimer Check Valves provide positive reverse-flow protection over a much longer, lower-cost service life.

Your Lunkenheimer Distributor has a stock of Check Valves for your needs. Call on him for your original equipment, replacement, and repair valve requirements.

THIS FEATURE IS ON ALL LUNKENHEIMER SWING CHECK VALVES

Two renewable side plugs serve as bearings for the disc carrier pin. In service, the disc carrier pin is subjected to various degrees of wear which, if not corrected, causes misalignment with consequent ineffective operation of the valves. The TWO side plugs provided in Lunkenheimer Swing Check Valves permit removal of the disc carrier pin from EITHER side—a particularly advantageous feature when valves are installed close to a wall or other obstruction. With this accessibility, it is easy to keep Lunkenheimer Swing Check Valves in good working condition.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

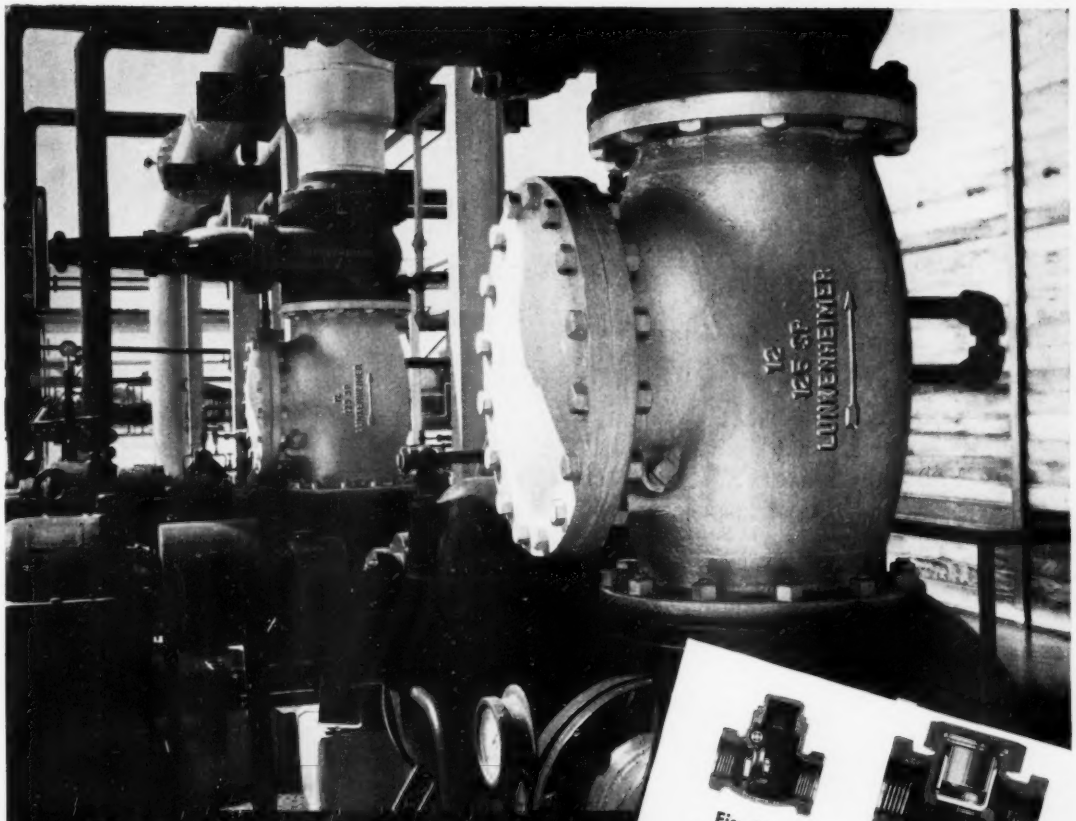
"QUALITY"

CINCINNATI 14, OHIO. U. S. A.

NEW YORK 13 CHICAGO 6

BOSTON 10 PHILADELPHIA 34

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.



More than 96 Types of

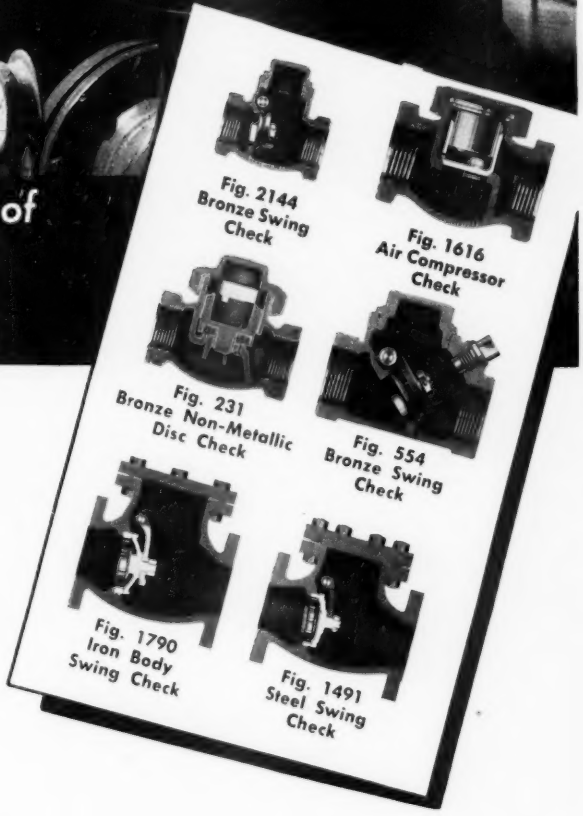
LUNKENHEIMER CHECK VALVES

Available in sizes and materials to meet every service requirement.

From small Bronze 125 lb. S. P. to massive steel patterns for pressures up to 2500 lb. S. P.

Complete line of Lunkenheimer Check Valves is described and illustrated in Circular No. 588.

Ask your Distributor for a copy or write direct.

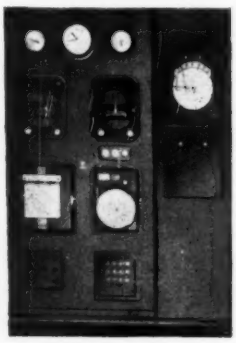


86 YEARS OF WATER CONDITIONING EXPERIENCE PROVES ITSELF

The fact that users of Cochrane water conditioning apparatus continue to come back to Cochrane for additional equipment when plants are expanded or new ones established is adequate proof of the consistently satisfactory operation of Cochrane softeners, deaerators, filters, etc.

Pittsburgh Plate Glass Company is one of Cochrane's old customers who have ordered and reordered Cochrane softeners year after year, some of these orders going back over thirty years.

The Cochrane Hot Process Softener installation at Pittsburgh's Columbia Chemical Plant at New Martinsville, W. Va., shown on these pages, was originally installed as a simple lime-soda softener to treat 40,000 GPH of Ohio River water having a calcium carbonate hardness of 40 ppm. The treated water is deaerated in the Cochrane Atomizing Deaerator section. The sedimentation tank also includes a separate tray type condensate deaerator having a capacity of 50,000 GPH.



Recently, because of the long retention time resulting from excess capacity, the softener has been used as a two-stage system by adding phosphate to the uptake funnel of the sedimentation tank.

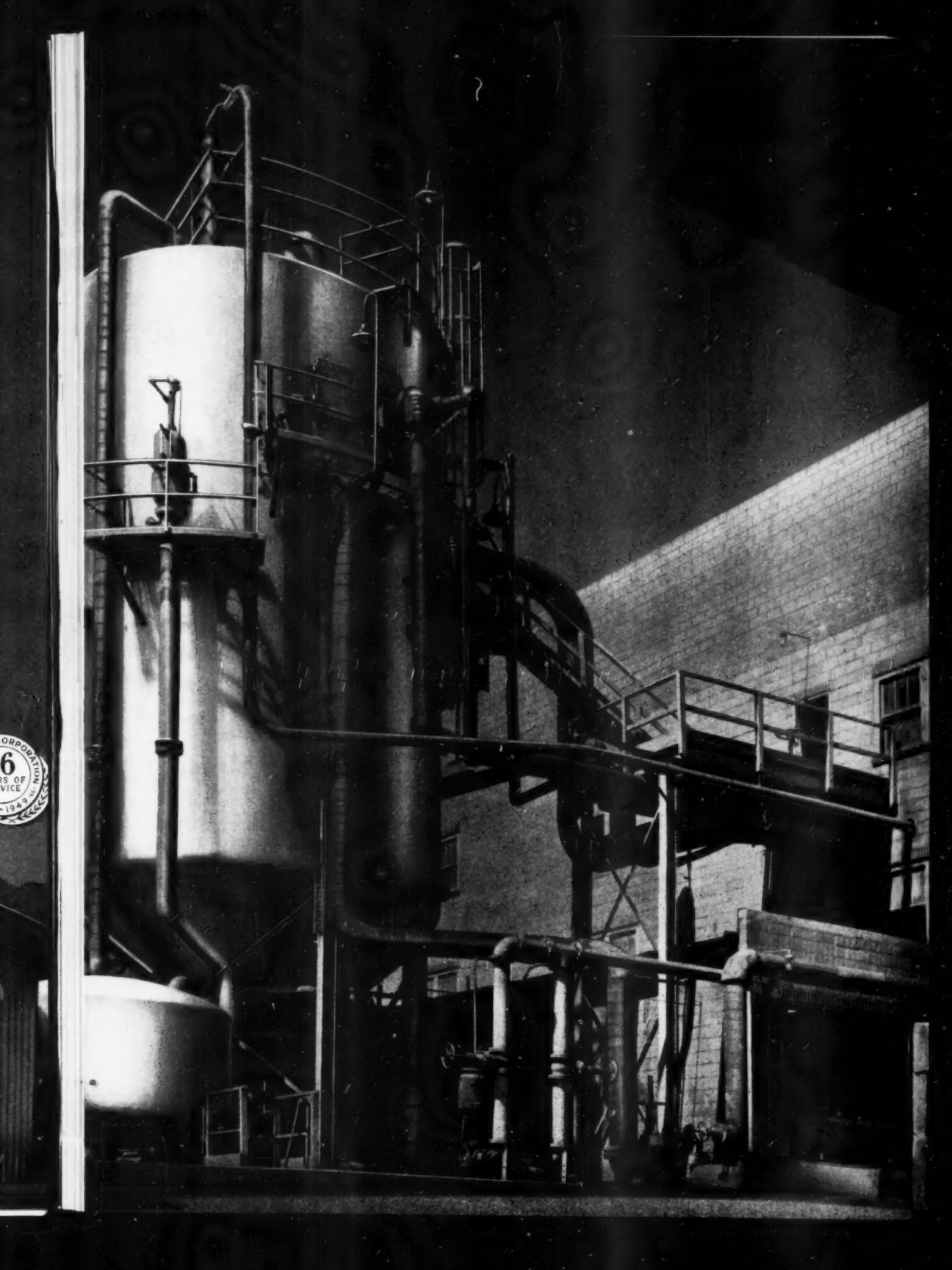
Controls are located conveniently on a panel board where adjustment of chemicals may easily be made by means of the Cochrane electrically operated proportioner.

COCHRANE CORPORATION · PENNA.

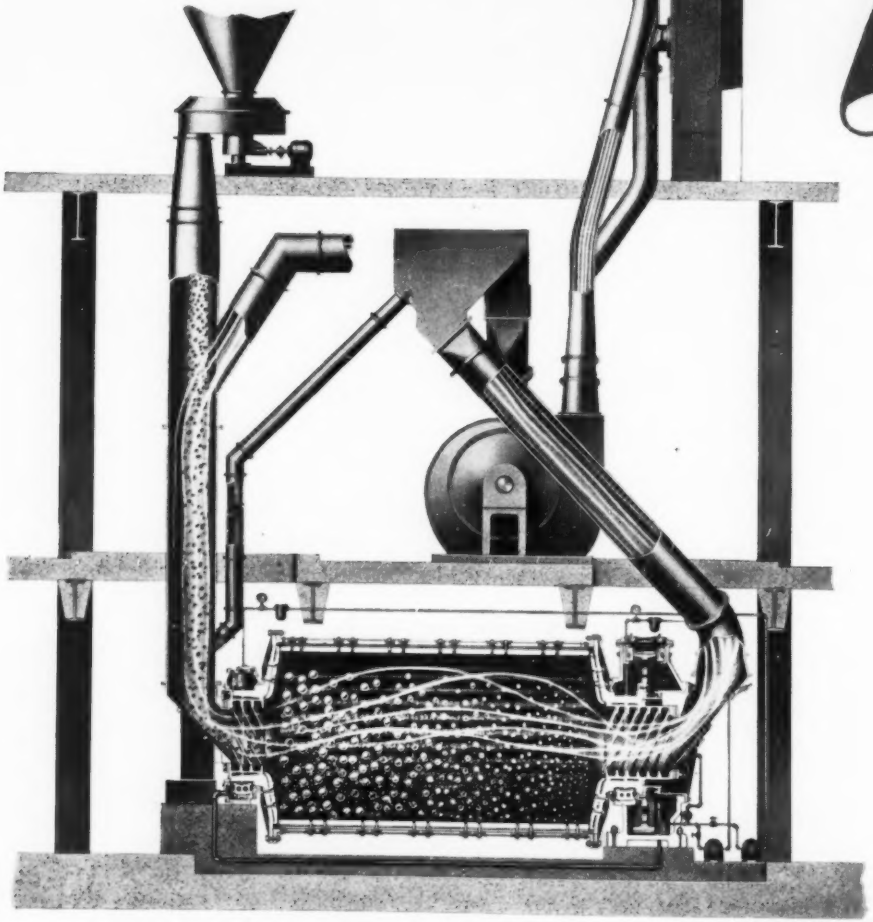
COCHRANE CORPORATION 86 YEARS OF SERVICE 1863 - 1949

COCHRANE CORPORATION · 3106 N. 17th Street
Philadelphia 32, Pa.

COCHRANE



Instant Response to



Combustion Controls with KVS Pulverized COAL FIRING

KVS Pulverized Coal Firing results in worthwhile savings on your fuel bill.

. . . Complete and rapid combustion through extremely fine pulverization are assured by the KVS Air Swept Tube Mill.

. . . unburnt carbon losses are less than one-half of one percent at all ratings.

. . . pulverized coal is available for full capacity requirements on instant demand.

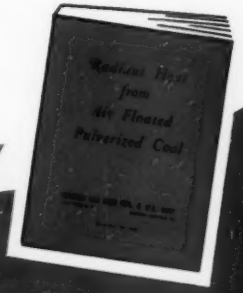
. . . load changes do not affect high efficiency.

KVS pulverized coal equipment is unusually free from service shut-downs. Continuous year-to-year, uninterrupted operation is common practice in large KVS-equipped power plants. It is unnecessary to shut down KVS Air Swept Tube Mills when adding balls for grinding. Investigate *all* the advantages of KVS pulverized coal fired steam generators before writing specifications.

KVS ENGINEERING SERVICE

Our engineers will furnish complete boiler designs for your steam requirements. Let us help you reduce your operating and fuel costs with KVS pulverized coal firing and KVS steam generators.

Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.



KENNEDY-VAN SAUN Kennedy Products NEW YORK USA MFG. & ENG. CORP. QUALITY SERVICE

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

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FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

Experience proved the value of

HAGAN Controls

at CROWN PAPER BOARD CO., Inc.

More than 25 years ago, Hagan Automatic Combustion Control was installed on three stoker-fired, natural draft boilers in the plant of Phil-Fibre Box Board Mills, in Philadelphia.

In 1933, these boilers were converted to oil, and the Hagan control system was modified accordingly. Expense of this modification, incidentally, was nominal. Records show continuous maintenance of 12-13% CO_2 with this old equipment.

The plant was sold to Crown Paper Board Co. in 1944, and the new owners undertook an extensive program of plant renovation. The largest of the old boilers, a 400 h.p. unit, was replaced in 1946 by a new 750 h.p. unit. Hagan Control was specified for this boiler. The instruments on the old boiler were used, and Hagan panel controls were added to the existing panel.

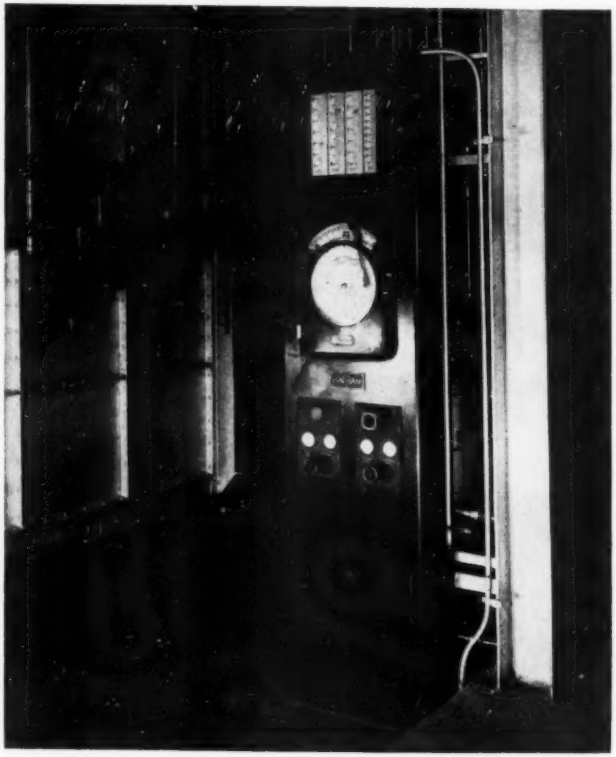
In 1947, another 750 h.p. boiler was placed in service, replacing the two 300 h.p. units. Again, Hagan Control was specified, and Hagan also supplied panel board and instruments, including a Hagan Ring Balance Steam Flow-Air Flow Meter. This meter was equipped with a third pen for recording stack temperature, and with an integrator which continuously totalizes steam flow.

After several months experience with the Hagan Control Panel and Ring Balance Meter on the new boiler, they ordered a new control panel, and an identical Hagan Ring Balance Boiler Meter for the older boiler.

The new boilers operate at 160 lb. pressure. They are oil fired, one having a turbine driven forced draft fan and the other having a motor drive fan. Maximum continuous rating of each boiler is 45,000 lb./hr.

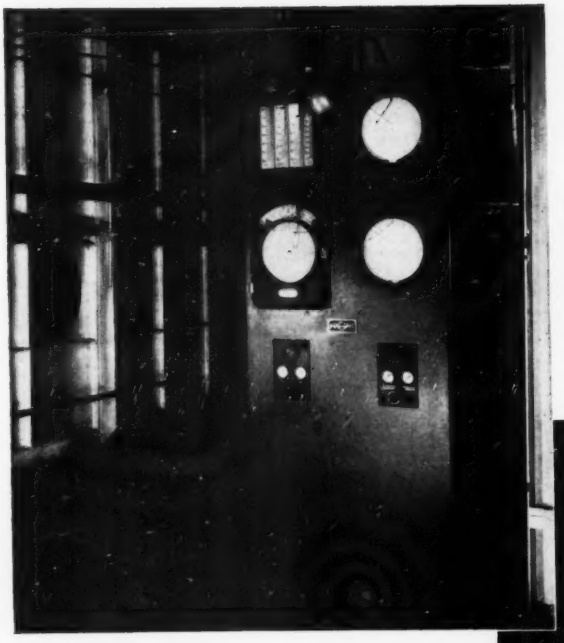
Load on these boilers normally ranges from 25,000 lb./hr. to 45,000 lb./hr. Occasionally breakage of paper in the mill causes a sudden drop in demand to 12,000 lb./hr. The controls adjust fuel-air ratio instantly, in accordance with demand, and meters follow the fluctuations accurately.

For full information on Hagan Combustion Control Systems and Hagan Ring Balance Meters, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.



The second of the two new boilers at Crown Paper Board was the first to have a new control panel with Hagan Ring Balance Steam Flow-Air Flow Meter.

and Meters



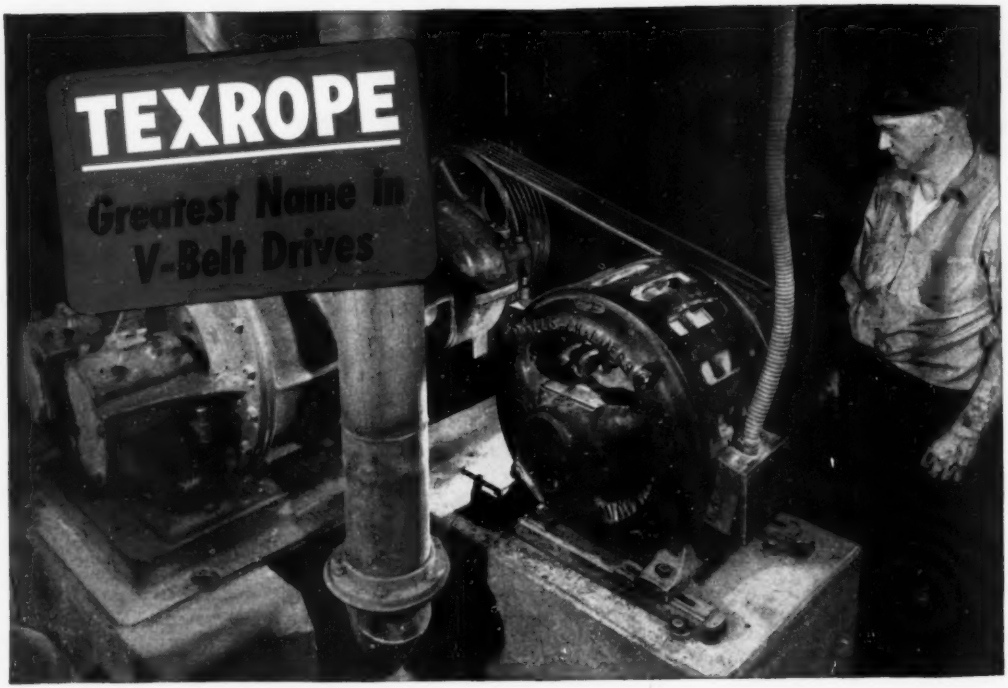
After the second boiler was placed in service, a new panel was installed for the first boiler, and this also was equipped with a Hagan Ring Balance Meter.

New boiler plant at Crown Paper Board. Consulting engineers were the Stewart A. Jellett Co., and contractor was John C. Kohler, both of Philadelphia. Crown's plant renovation program, of which this is a part, is directed by R. S. Brookover, General Manager.

HAGAN
HALL
BURDMIN
CALGON

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES



"No Upkeep Now"

BELT SLIP ELIMINATED, BEARING DAMAGE STOPPED, POWER WASTE ENDED WHEN *TEXROPE* V-BELT DRIVE REPLACES FLAT BELT.

CHIEF PLANT ENGINEER in this midwest plant says, "The old flat belt on this blower drive was twelve inches wide on twenty foot centers. Not only was it heavy but it also absorbed a lot of power.

"Besides that, dust made the belt slip constantly. We had to keep the belt so tight that it ruined bearings. And slipping would burn the belt. Maintenance on our old flat belt drive cost us hundreds of dollars every year.

"Four years ago an Allis-Chalmers representative recommended this *Texrope* drive. It doesn't slip at all, doesn't hurt the bearings and we haven't spent a cent on it. I wish we had changed to a *Texrope* drive years sooner."

Money-saving performance like this is one of the reasons why more *Texrope* industrial V-belt drives have been installed since 1926 — when Allis-Chalmers originated the multiple V-belt drive — than any other kind.

The *Texrope* line gives you practically everything you need for any V-belt drive . . . V-belts, standard and *Vari-Pitch* sheaves and speed changers . . . all from one reliable source. You can engineer 90% of all V-belt drives yourself with the help of the *Texrope* Pre-engineered Drive Manual. See your A-C Authorized Dealer or District Office or write for Bulletin 20B6956. Also in Sweet's.

Texrope Super-7 V-belts result from the cooperative research of Allis-Chalmers and B. F. Goodrich; and are sold only by A-C dealers and offices. *Texrope* and *Vari-Pitch* are Allis-Chalmers trademarks. A 2648

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE. WIS.

ALLIS-CHALMERS

Sold . . .
Applied . . .
Serviced . . .

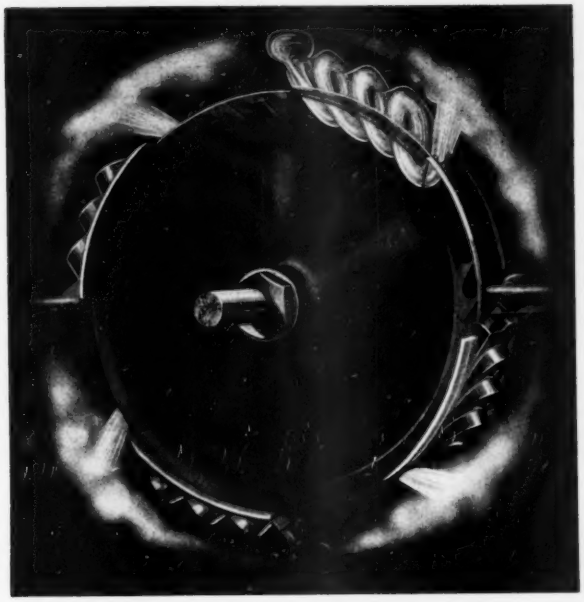
by Allis-Chalmers Authorized Dealers, Certified Service Shops and District Offices throughout the country.

MOTORS — ½ to 25,000 HP and up. Matching Allis-Chalmers Control.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

TERRY



BLADE PROTECTION

Made Possible by Nozzle Location

In the Terry Solid-Wheel Turbine, the steam enters the buckets from the top, not from the side of the wheel, as shown in the illustration above. This permits a one inch clearance on either side of the wheel. In addition, projecting rims on each side of the buckets prevent damage to the blades even though excessive thrust should tend to move the shaft.

This feature and others, as important, are described in detail in Bulletin S 116 which will be sent to you on request.

T-1175

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

It's repeat orders that count!

DETROIT ROTOGRATE STOKERS

Third—210,000 pound capacity RotoGrate ready for shipment to The Studebaker Corporation—Automotive Plant, South Bend, Ind.

For Greater Economy in Steam Production use Detroit RotoGrate, the original spreader stoker with forward moving, continuously cleaning grates that discharge the ash at the front.

Other types and sizes of Detroit Stokers for every industrial or power need

Repeat orders are always convincing proof of satisfaction. RotoGrate users order again and again, because they find that

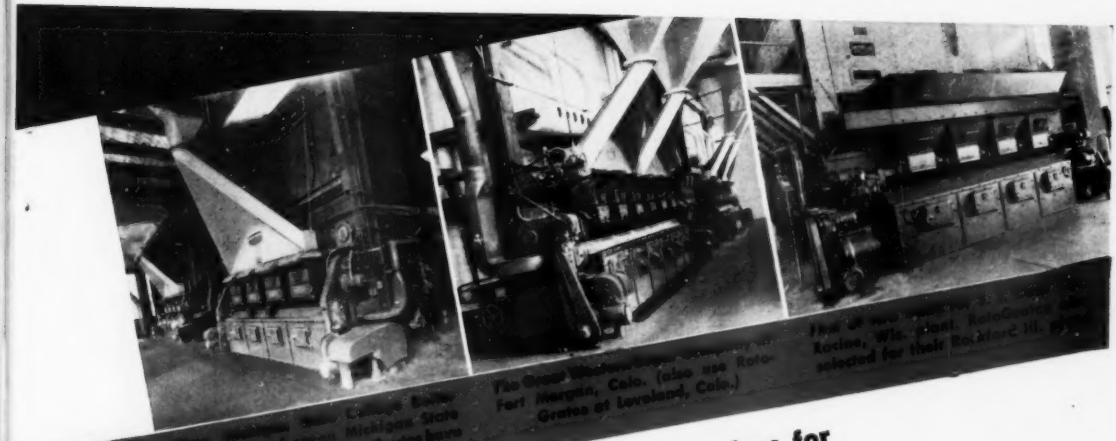
"Detroit RotoGrate Stokers reduce their cost of producing steam"

by efficiently burning any Bituminous coal or Lignite. They permit much higher burning rates to produce more capacity per foot of furnace width, thus holding down investments in both generating equipment and building.

RotoGrates handle fluctuating loads, without sacrifice in economy. Reliable availability is high.

May we serve you? • Write for Bulletin.

DETROIT SINCE 1898 STOKERS



Fort Morgan, Colo. (also see Roto-Grates at Loveland, Colo.)

Prominent users who have placed repeat orders for DETROIT ROTOGRATE STOKERS:

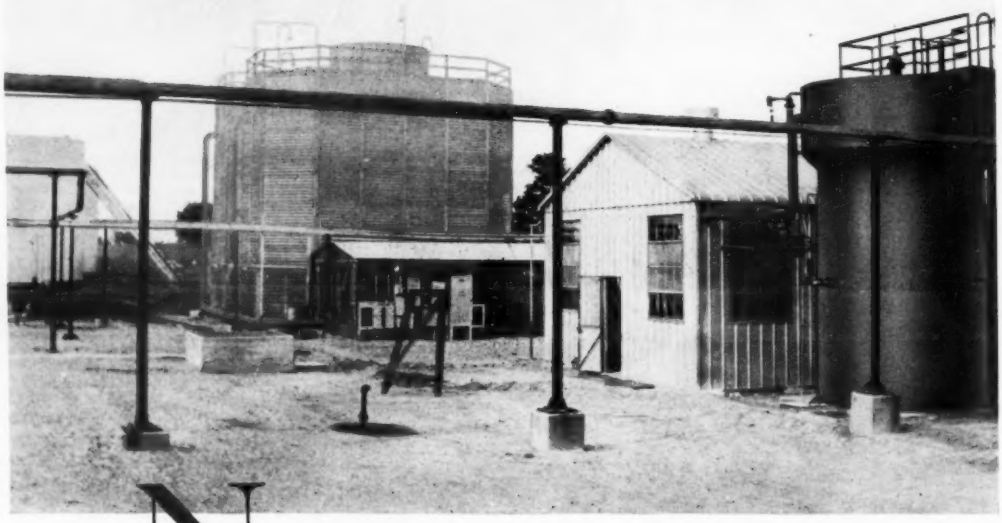
- **AMERICAN BOX BOARD CO.**—Two Contracts since 1942; Total capacity, 230,000 lb.
- **CENTRAL ILLINOIS ELECTRIC & GAS CO.**—Four Contracts since 1945; Total capacity, 960,000 lb.
- **CHRYSLER CORP.**—Seven Contracts since 1940; 13 RotoGrates—Total capacity, over 1,000,000 lb.
- **CONSOLIDATED PAPER CO.**—Two Contracts since 1946; Total capacity, 300,000 lb.
- **GENERAL MOTORS CORP.**—Ten Contracts since 1942; 21 RotoGrates—Total capacity, over 1,600,000 lb.
- **INTERNATIONAL PAPER CO.**—Three Contracts since 1948; Total capacity, 335,000 lb.
- **IOWA PUBLIC SERVICE CO.**—Six Contracts since 1941; Total capacity, 600,000 lb.
- **J. I. CASE CO.**—Three Contracts since 1942; Total capacity, 270,000 lb.
- **JOHN DEERE DUBUQUE TRACTOR CO.**—Two Contracts since 1945; Total capacity, 240,000 lb.
- **LEVER BROTHERS CO.**—Two Contracts since 1947; Total capacity, 285,000 lb.
- **MONTANA-DAKOTA UTILITIES CO.**—Two Contracts since 1947; Total capacity, 135,000 lb.
- **MOORHEAD, MINNESOTA MUNICIPAL POWER PLANT**—Two Contracts since 1945; Total capacity, 110,000 lb.
- **MOTOR WHEEL CORP.**—Two Contracts since 1942; Total capacity, 140,000 lb.
- **MUSCATINE, IOWA, MUNICIPAL PLANT**—Two Contracts since 1941; Total capacity, 260,000 lb.
- **NEW YORK CENTRAL SYSTEM**—Two Contracts since 1947; Total capacity, 125,000 lb.
- **NORTHERN STATES POWER CO.**—Five Contracts since 1946; Total capacity, 900,000 lb.
- **PETER COOPER CORPORATIONS**—Three Contracts since 1946; Total capacity, 220,000 lb.
- **PUBLIC SERVICE COMPANY OF OKLAHOMA**—Three contracts since 1941; Total capacity 625,000 lb.
- **PULLMAN STANDARD CAR MANUFACTURING CO.**—Two Contracts since 1945; Total capacity, 240,000 lb.
- **ROHM & HAAS CO.**—Three Contracts since 1946; Total capacity, 325,000 lb.
- **SIOUX CITY GAS AND ELECTRIC CO.**—Two Contracts since 1944; Total capacity, 170,000 lb.
- **STATE OF MICHIGAN**—Ten Contracts since 1945; 18 RotoGrates for 7 institutions; Total cap., 912,000 lb.
- **STATE UNIVERSITY OF IOWA**—Two Contracts since 1938; Total capacity, 178,000 lb.
- **TENNESSEE EASTMAN CORP.**—Three Contracts since 1946; Total capacity, 525,000 lb.
- **THE GREAT WESTERN SUGAR CO.**—Two Contracts since 1946; Total capacity, 500,000 lb.
- **THE NORTHWEST PAPER CO.**—Two Contracts since 1945; Total capacity, 200,000 lb.
- **THE STUDEBAKER CORP.**—Three Contracts for Automotive Plant—Total 630,000 lb, and one Contract for Truck Plant—Total 150,000 lb, all since 1940.
- **WALWORTH COMPANY, INC.**—Two Contracts since 1943; Total capacity, 120,000 lb.
- **WEST VIRGINIA PULP & PAPER CO.**—Three Contracts since 1944; Total cap., 400,000 lb.

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

Works at Monroe, Michigan, District Offices in Principal Cities

This modern refinery installation at Mt. Vernon, Indiana, shows a Worthington Precipitating Slurry-Type Cold Process Water Softener in the right foreground; cooling towers in background.



No other slurry-type cold process softens water this simple way

NO MECHANICAL AGITATION!

This *unique* Worthington Water Softener assures delivery of the uniformly soft, stabilized, clear water needed for scale-free, corrosion-free cooling water systems.

The unique Worthington feature is the scientific use of hydraulic energy provided by the pressure of the general water supply system to maintain the slurry bed. This eliminates the need for moving agitating parts for mixing the applied chemicals with the preformed precipitate.

WHAT'S YOUR WATER TREATING PROBLEM?

The right water conditioning process for one problem may be wrong for another. That's why it pays to call in Worthington, the century-old water-handling equipment maker that knows more about the complicated problems of applying *all four* water conditioning processes than anybody else. Remember, Worthington makes all the essential elements of all kinds of systems. So, by putting complete control and responsibility in the hands of one reliable manufacturer, you can be sure that your water conditioning plant is right for you.

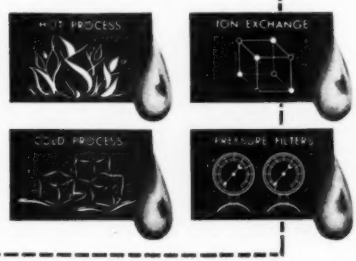
Write today for more information about cold process water softening, and further proof that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Division, Harrison, N. J.*

J8.4

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



For Heavy Duty Steam Generating Plants

Springfield's

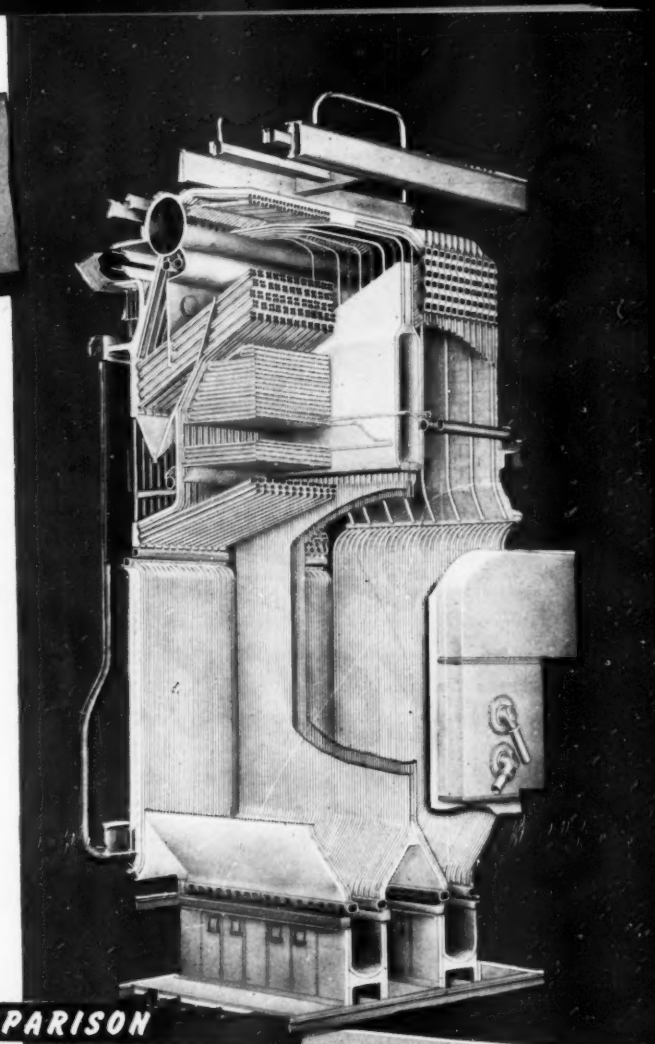
DIVIDED FURNACE WITH CENTER WATER WALL

THE divided furnace with a CENTER WATER WALL* is a development first introduced by Springfield Boiler Co., for large central station installations. It has application where gas temperatures entering the first pass and superheater must be limited to prevent overheating of the center section of the wider furnaces. It enables a unit to stay on the line longer before shutting down for maintenance and cleaning.

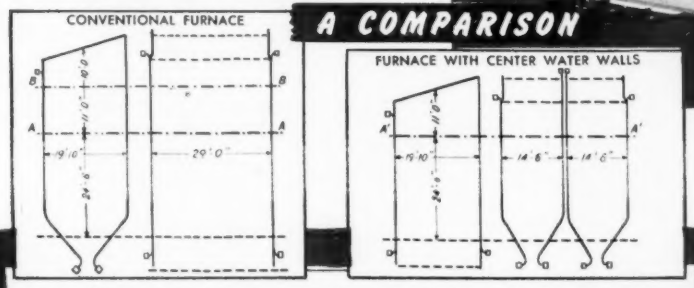
The divided furnace construction has been highly dependable and successful in service. It is adaptable to any kind of firing. Springfield offers it on both bent tube and straight tube boiler designs.

*Patented

CHECK WITH YOUR CONSULTING ENGINEER ON YOUR MODERNIZATION AND NEW PLANT PROJECTS



A COMPARISON



These diagrams show how the *center water wall* made it possible for Springfield to reduce the height of furnace 22% on one 350,000 lb. pulverized coal fired unit in addition to securing a more even gas temperature entering the first pass across the width of the unit.

SPRINGFIELD PRODUCTS

BENT TUBE STEAM GENERATORS—Modern designs for capacities from 10,000 lbs. up.

STRAIGHT TUBE BOILERS—Specially designed for capacities from 5,000 to 450,000 lbs. per hour and higher.

STANDARDIZED TYPE M BOILERS—Standardized for quicker delivery and lower cost. Sizes 6,000 to 17,000 lbs. per hour.

WATER COOLED FURNACES—Heavy duty water walls. Exclusive center water wall construction for larger units.

SUPERHEATERS — AIR HEATERS — ECONOMIZERS—Individually designed to meet requirements.

SPRINGFIELD BOILER CO.

1953 E. CAPITOL AVENUE — SPRINGFIELD, ILLINOIS

Worldwide Sales and Service

NEW YORK • PHILADELPHIA • WASHINGTON, D. C. • DETROIT • SALEM, MASS. • HOUSTON
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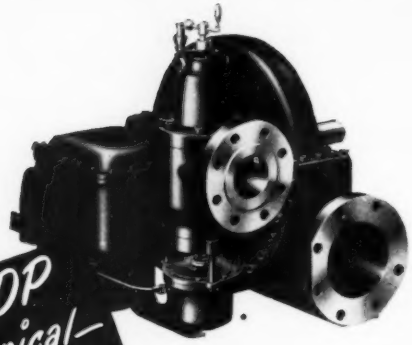
SPRINGFIELD BOILERS

See our catalog in SWEET'S



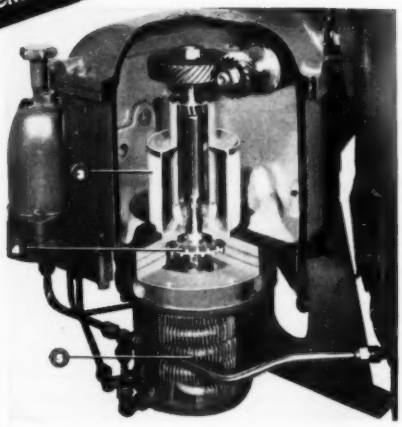
GE Type DP Mechanical-Drive Turbine

LOOK AT THESE

Better Governing

1. 30% ADJUSTABLE SPEED RANGE is wider than obtainable with mechanical governors.
2. RELIABILITY even after long standby assured by totally enclosed, continuously lubricated hydraulic governor.

Better Lubrication



3. CLEAN OIL maintained by bronze mesh oil strainer.
4. POSITIVE PRESSURE furnished by turbine-type oil pump.
5. ADEQUATE OIL COOLING provided by high-capacity fin-tube oil cooler.

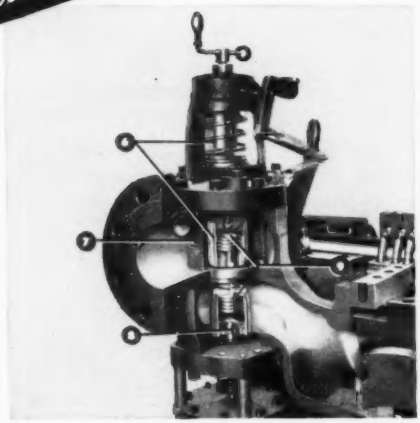
SPECIAL FEATURES

—AT NO EXTRA COST

YOU get a host of special features in the Type DP line of mechanical-drive turbines—features which provide better governing, lubrication, valving, and less maintenance than previous standard units. These features, formerly obtainable only on costlier "special" machines, are standard on the DP—at no extra cost.

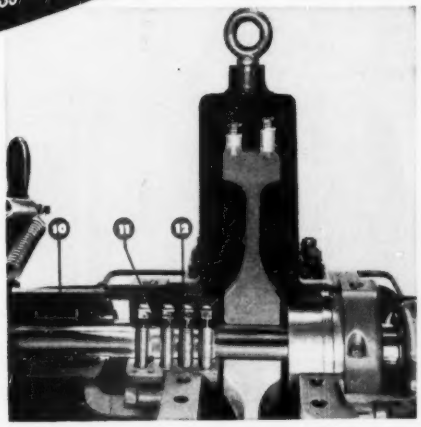
If you have a turbine application, be sure to investigate the time and trouble-saving features of the DP. Your G-E representative will be glad to give you all the facts. Apparatus Department, General Electric Company, Schenectady 5, New York.

Better Valving



6 COST OF SEPARATE SHUT-OFF VALVE often saved by combined trip-throttle valve.
7 LONG LASTING heavy Monel steam strainer.
8 MAINTENANCE REDUCED by valve stem sealing bushings—no soft packings required.
9 EASY ONE-HAND OPERATION with balanced valve design.

Less Maintenance



10 LONG BEARING LIFE assured by solid-backed bearings.
11 SHAFT EROSION PREVENTED by Monel spray under packings.
12 STEAM LEAKAGE sealed off by heavy double-seal carbon packings.

GENERAL ELECTRIC

Spins a centrifugal sixteen months

—24 hours a day!

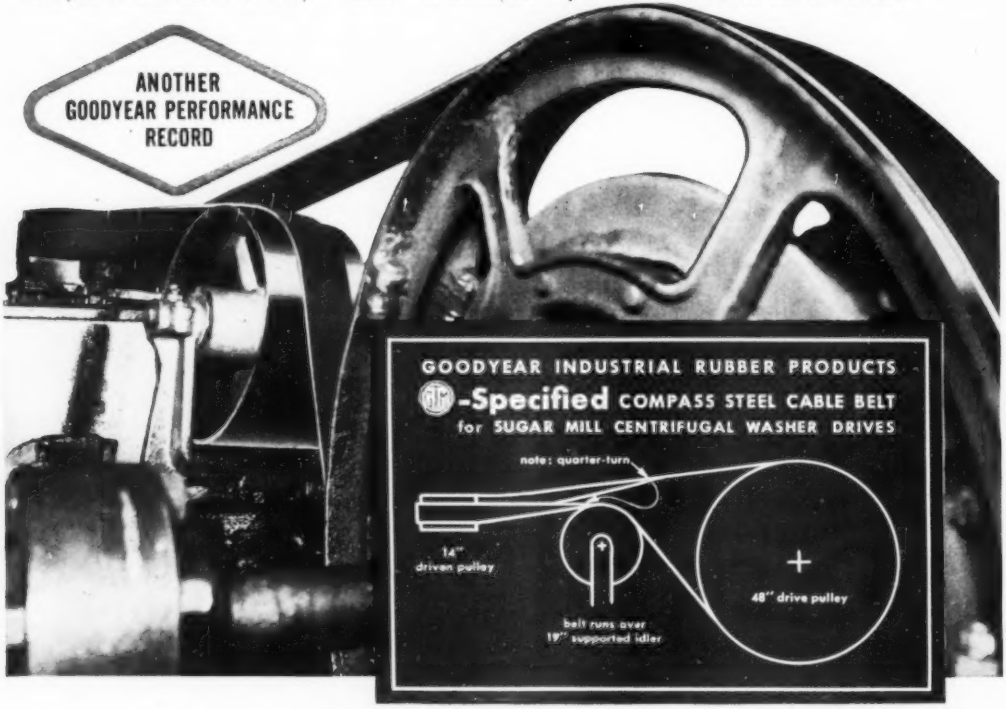
CENTRIFUGAL washers in a Louisiana sugar mill were "eating" belts of heaviest conventional construction—wearing out seven-inch-wide seven-ply belts at a rate only slightly less than one every two months. Reason was the heavy fluctuation in H.P. demands, coupled with a difficult quarter-turn drive. Belts had to be taken up frequently—cost the mill hundreds of dollars in lost production during their relatively short on-the-job life.

So costly was the drive—both in belts and maintenance—that the mill operator called in the G.T.M.—Goodyear Technical Man—to study the problem. To tame this "killer" drive, the G.T.M. recommended installing a COMPASS Steel Cable belt *only four inches wide*. The first belt installed ran for 16 months—24 hours a day! *And without a single shutdown for take-up.* So phenomenally successful was the performance of this belt that now all 18 washers in the mill are COMPASS equipped.

Today these 18 Goodyear belts are running the washers day in, day out—at a lower cost than the previous belts and with no maintenance problems. Secret of their performance is Goodyear's patented COMPASS construction, with truly endless, wiry-steel cables bonded in rubber to form the load-carrying "muscles" of the belt—giving it super-strength combined with practically zero stretch.

Wherever you have a problem drive, it will pay you to consult the G.T.M. for belting recommendations. Write him c o Goodyear, Akron 16, Ohio.

FOR HOSE, FLAT BELTS, V-BELTS, MOLDED GOODS, PACKING, TANK LINING *built to the world's highest standard of quality, phone your nearest Goodyear Industrial Rubber Products Distributor.*



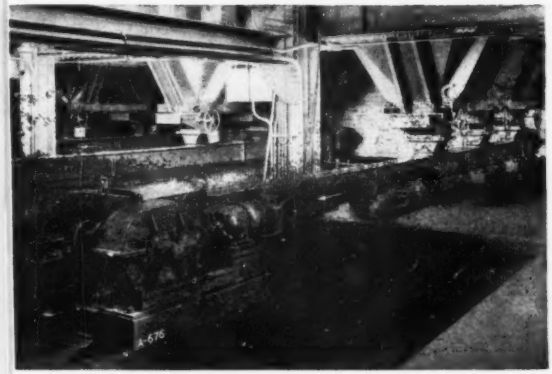
We think you'll like "THE GREATEST STORY EVER TOLD"—Every Sunday—ABC Network

GOODYEAR

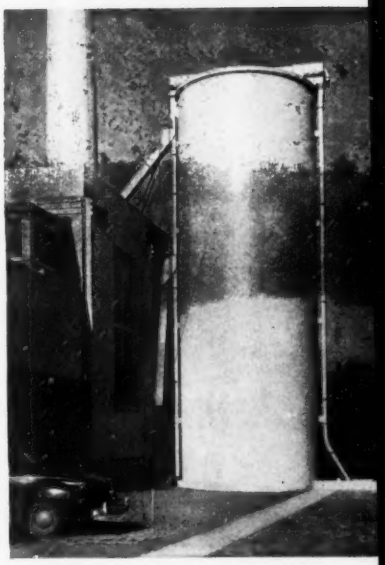
Compass—T.M. The Goodyear Tire & Rubber Company

THE GREATEST NAME IN RUBBER

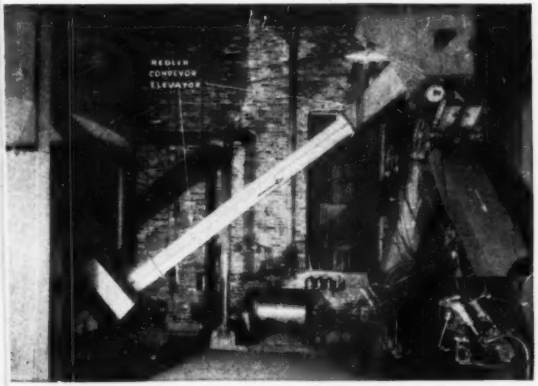
Handle Coal and Ash faster, at low cost with S-A Conveyors and Elevators



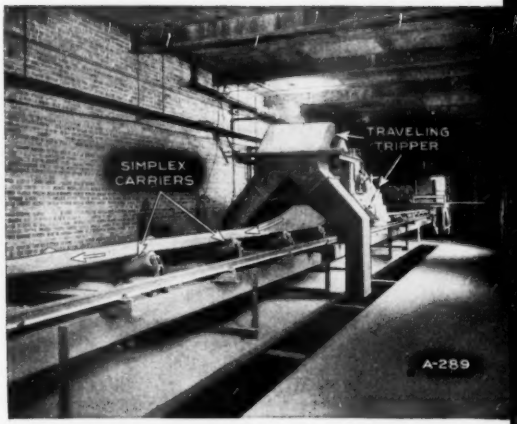
AUTOMATIC CONTROL of coal handling from bunkers to pulverizers at this large generating station is made possible with REDLER conveyors. Eight horizontal REDLERS withdraw coal from storage bunkers. Dust-tight casings prevent escape of coal dust. Installation required only small amount of space due to compact REDLER design. Enclosed, dust-tight gates on bottom of bunkers were also built by S-A. Write for information on S-A equipment for handling coal at lowest cost.



FOOD PLANT receives coal from storage silo. Coal is carried to silo from track hopper by horizontal REDLER conveyor in shallow trench. Compact REDLER encircling silo elevates coal to top for storage, or carries coal from slide gates at bottom of silo to boiler room stoker chutes. Sealed casing prevents escape of any coal dust. Write for data on product-protecting cost-cutting S-A conveyor systems for power plants.



NO DIRT. Coal dust has been eliminated from many boiler rooms with compact, dust-tight REDLER conveyor units like this. One conveyor draws coal from storage, elevates, and fills several stoker hoppers. In other cases, closed-circuit REDLERS store and reclaim from any part of large storage bunkers. Write for suggestions on a compact, economical conveyor system for your power plant.



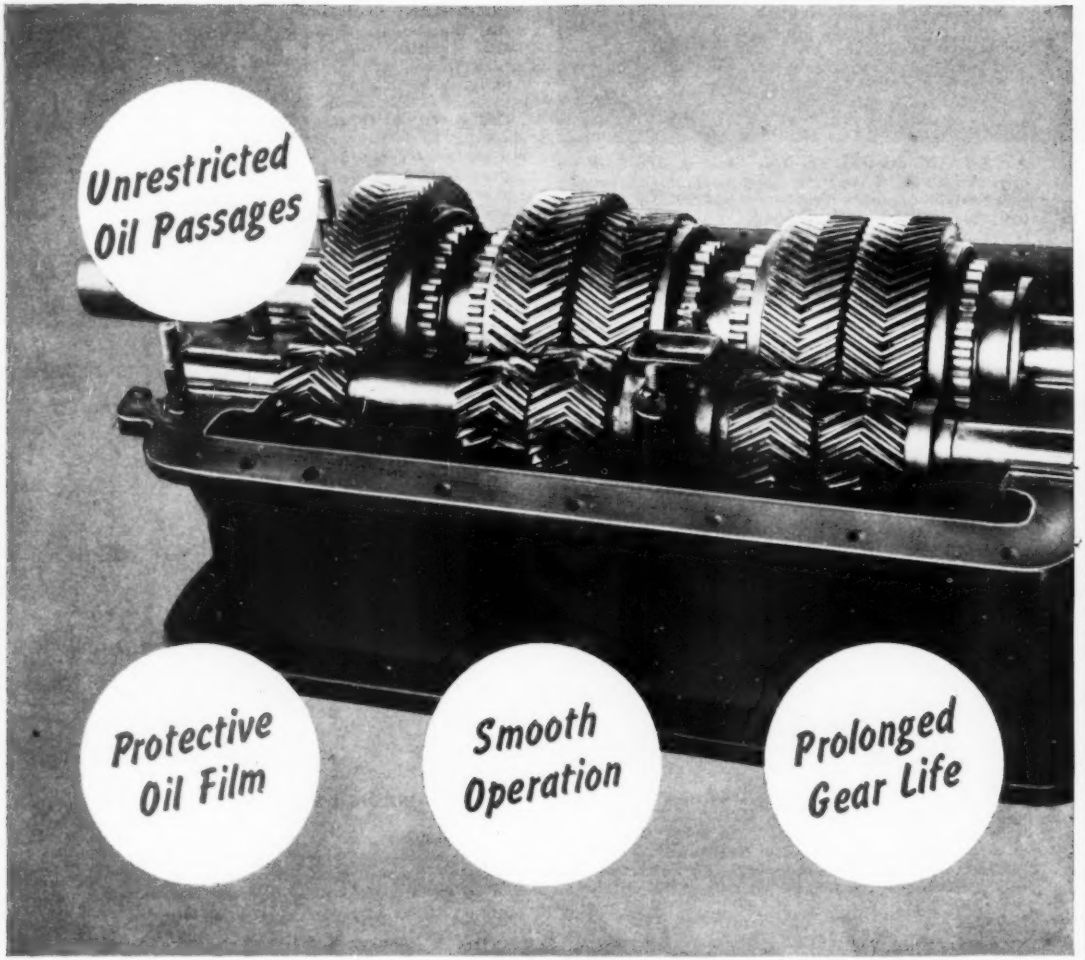
HANDLING COAL YOUR PROBLEM? This is one of many S-A engineered answers. This system includes an S-A Belt Conveyor over a coal bunker in a power plant. Movable, self-propelled tripper on rails discharges coal from belt at any desired point. Idlers are S-A SIMPLEX type, equipped with Timken roller bearings. Find out about other cost-cutting S-A Conveyor Units and Systems. Write today.

STEPHEN S-A ADAMSON
MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

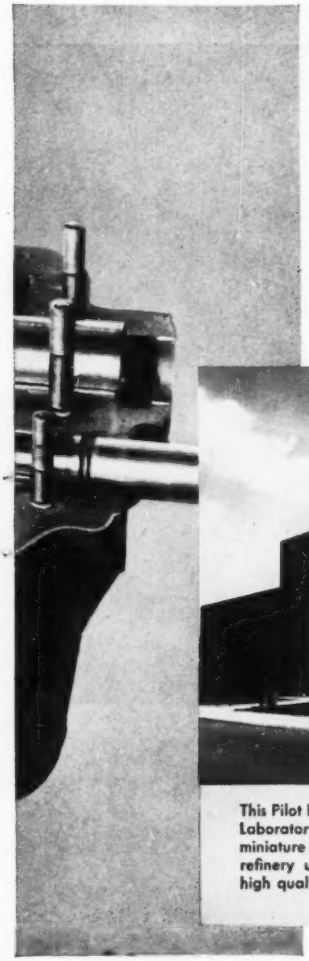
SINCLAIR RUBILENE To Promote



SINCLAIR

YOUR NEAREST SINCLAIR AGENT WILL GLADLY ARRANGE

Withstands Punishment Gear Efficiency



Inside a Speed Reducer, the lubricating oil is being churned and temperatures run high. This promotes oil oxidation, and formation of acidic compounds, gum and sludge. The result is lower efficiency, accelerated bearing and gear wear—perhaps even complete failure.

With Sinclair RUBILENE as the lubricant, the danger of insufficient lubrication and excessive wear are no longer a worry. Product of the most modern refining processes, RUBILENE resists oxidation, thereby retarding the formation of damaging acidic compounds, gum and sludge. It is non-foaming, too. So, with a constant flow of protective oil to bearings and gears, RUBILENE stands up under the day-in-and-day-out continuous gear operation . . . without frequent need for draining or replacement. Try Sinclair RUBILENE Oils.

This Pilot Plant, part of the great Sinclair Research Laboratory at Harvey, Ill., provides space for six miniature operating replicas of commercial-sized refinery units. Continuous research explains the high quality of RUBILENE and other Sinclair Oils.

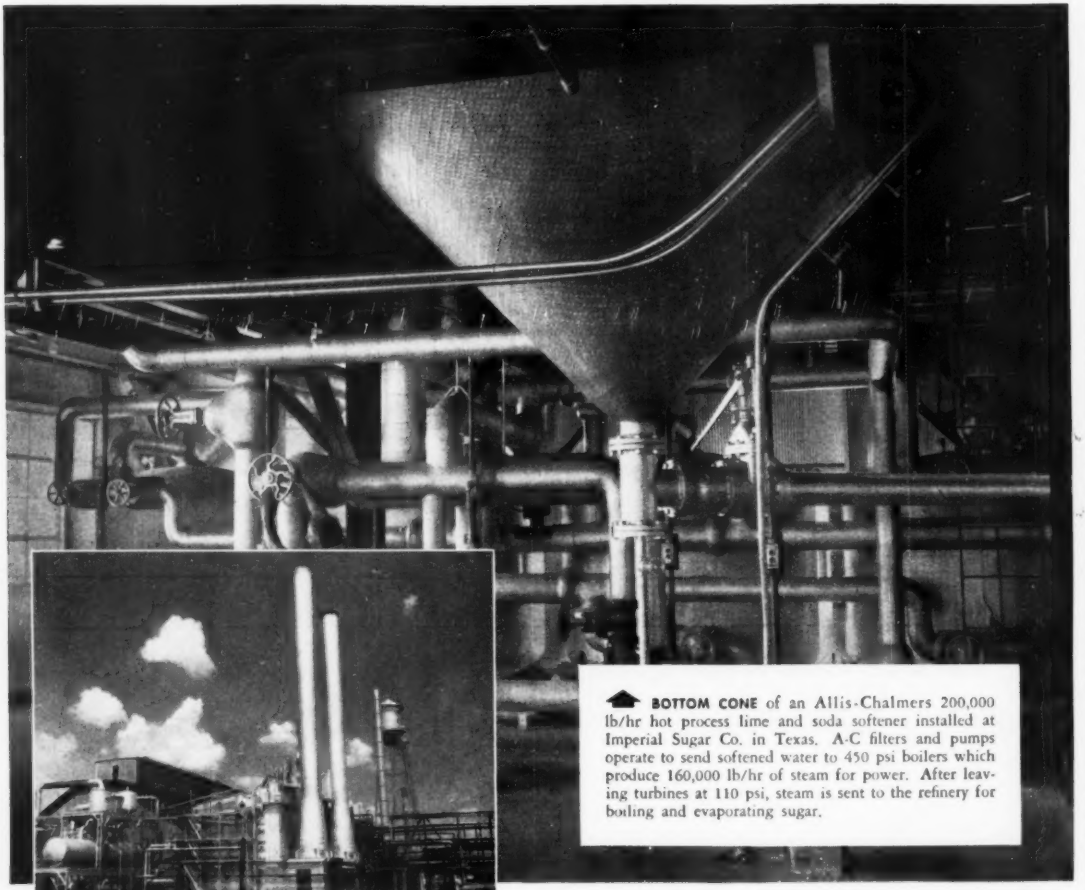
Making a study of crystal structure of catalysts, this Sinclair researcher at Harvey uses physical chemistry to develop refinery techniques in a never ending effort to bring industry better petroleum products at lower costs.

INDUSTRIAL OILS

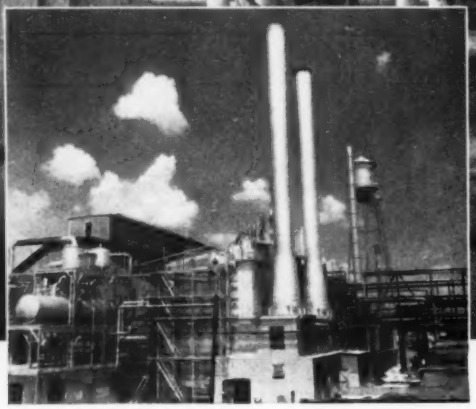
FOR LUBRICATION COUNSEL, OR YOU MAY WRITE TO SINCLAIR REFINING COMPANY, 630 FIFTH AVE., NEW YORK 20, N. Y.

ONE OF A SERIES • • • *Allis-Chalmers Water Conditioning*

3-way program water treatment



BOTTOM CONE of an Allis-Chalmers 200,000 lb/hr hot process lime and soda softener installed at Imperial Sugar Co. in Texas. A-C filters and pumps operate to send softened water to 450 psi boilers which produce 160,000 lb/hr of steam for power. After leaving turbines at 110 psi, steam is sent to the refinery for boiling and evaporating sugar.



CLEAN STEAM for sugar processing leaves the new power plant for the Southwest's leading sugar refinery, helping to produce 1,600,000 lb of refined sugar per day.

ALLIS-
Water Conditioning

(SERVICE • CHEMICALS • EQUIPMENT) *at Work in Industry*

helps you solve problems!

WHAT ALLIS-CHALMERS *SERVICE-CHEMICALS-EQUIPMENT* DOES FOR THESE FOOD PLANTS—IT CAN DO FOR ANY INDUSTRY THAT NEEDS COMPETENT TIME AND MONEY SAVING AID!

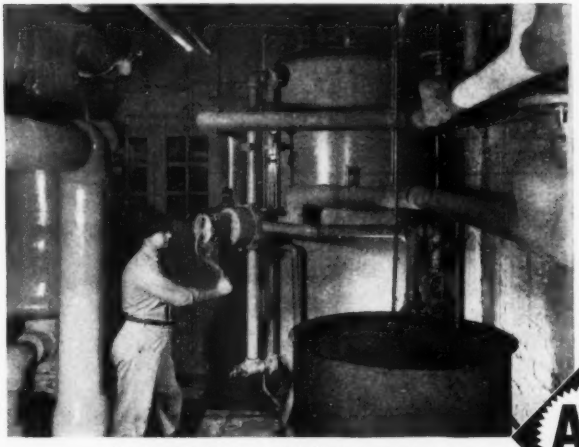
PLANT MEN IN FOOD-PRODUCING industries like sugar refining and dairying, for example, know the need for action when water treating problems arise. They know, too, that to work with a competent water conditioning organization means a savings in time and effort for all concerned.

For *all* industries, Allis-Chalmers in the water conditioning field not only provides a first hand study of water treating needs, but works right along with customer engineers in selecting the right process and correct equipment.

ALLIS-CHALMERS SERVICE starts with a complete study of water supplies and impurities, surveys of present methods and plant operating conditions. Following this: recommendations, selection of chemicals, periodic reports, and service calls.

CHEMICALS comprise a complete new line of formulations for scale and corrosion control in all types of cooling towers and heat exchangers. Also reliable AKON and SILIMITE which effectively prevent boiler scale and corrosion . . . reduce silica.

EQUIPMENT includes hot and cold process softeners, sodium and hydrogen zeolite softeners, degasifiers, deionizers, chemical proportioners, and oil removal and water filters.



SODIUM ZEOLITE softener at Pabst Farms Dairy in Wisconsin is a 9,000 gal unit treating extremely hard well water for steam-pasteurizing and evaporating fresh milk.

Akon and *Silimite* are Allis-Chalmers trademarks

CHALMERS

Service . . . Chemicals . . . Equipment

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

Please send me:

- ☐ 6385A Chemicals and Equipment, Analysis Instructions and Price List
- ☐ 6611 Description of Hot Process Water Softeners
- ☐ 7107 Sodium Zeolite Softeners

Name.....

Company.....

Title.....

City.....

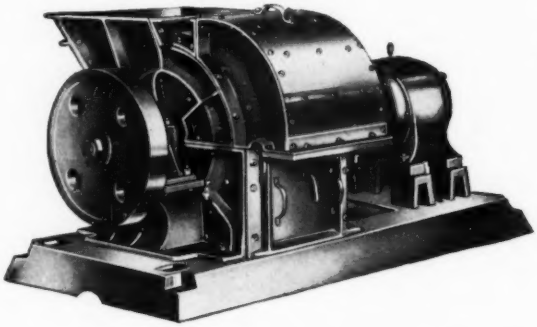
State.....

A 2639

ASSURE MORE EFFICIENT *FIRING* THROUGH MORE EFFICIENT *PREPARATION* with AMERICAN CRUSHERS

Shown above is the preparation plant of the Windsor Power House Co., Power, W. Va., where the American Rolling Ring Crusher Model 42S (in insert) is in daily operation.

Quality of coal crushing is as important to combustion efficiency as the quality of coal itself—one reason why Americans are chosen by so many power plants to do the crushing job. The *splitting action* of Americans assures uniform sizing—no oversize—and fines are accurately controlled. The result: a dependable, constant yield of stoker or pulverizer size to assure a uniform, responsive firebed—for greater operating efficiency.



Designed especially for power plants, the American "S" Crusher is a compact, complete crushing operation which is installed in minimum headroom without extensive conversion—and with no auxiliary crushing facilities. Nine different sizes, with capacities from 25 to 500 TPH.

Write for bulletin on efficient coal preparation in power plants.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE.
ST. LOUIS 10, MO.

Precision Produced

...from Globe Seamless Steel Tubes to Globe Welding Fittings

Your preference for Globe Welding Fittings is supported by a source of supply with exceptional qualifications. Specialized metallurgical experience and facilities gained in years of steel tubing manufacture enable Globe to produce welding fittings by a precision process that yields a superior product.

Send for the Globe Welding Fittings Catalog.

GLOBE STEEL TUBES CO.
Milwaukee 4, Wisconsin

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe welding fittings.

GLOBE
PRECISION PROCESS
WELDING FITTINGS

"Fingerprinting"

tube troubles

When a deposit causes trouble in a boiler tube, X-ray examination of the material frequently gives information which is not easily obtained by any other means.

In the examination of such deposits, X-rays are directed on a very small sample of finely powdered material. Each crystal diffracts a small portion of the incident X-ray beam, the angles of diffraction depending on the composition and crystal structure of the material. The diffracted beams are recorded on a film, and the pattern which results is an integrated picture of the sample.

Diffraction patterns made by the various compounds found in boiler deposits are as individual as human fingerprints, and provide just as positive identification. A deposit from a boiler tube usually yields a pattern which is a composite of several different compounds. The individual constituents are picked out by comparison with standards, the "fingerprints" of pure compounds.

● A typical example of this X-ray "fingerprinting" is the analysis of deposits containing calcium phosphate. There are two forms of calcium phosphate found in boilers. It is frequently desirable to know which is present. Chemical analysis and microscopic examination of the usual sample do not permit ready distinction between them. On the other hand, when samples containing the two forms are ignited, totally different patterns for the calcium phosphate constituent are obtained. The illustration shows this wide difference.

Positive identification of a compound when other methods might give uncertain results is only one of the advantages of X-ray examination—and the X-ray is only one of the full kit of "tools" used by Hall Laboratories in their study of your boiler problems. The thoroughness of Hall methods, employing every technique which might be of value, explains why so many plants of all types and sizes, in all parts of the country, are using Hall service.

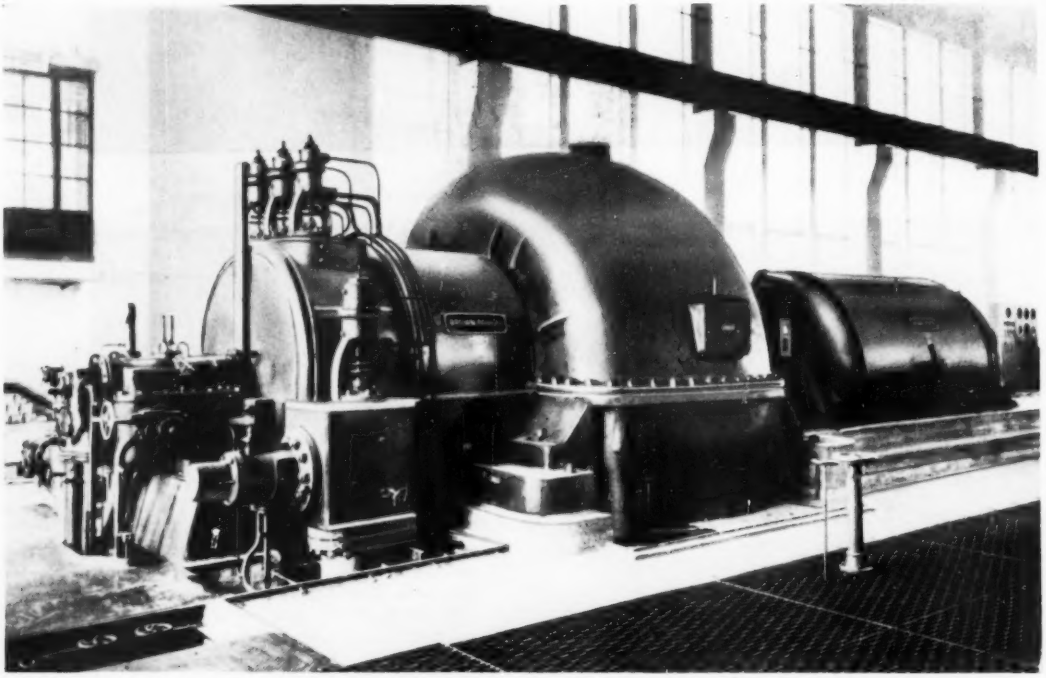
Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pennsylvania.

HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

Cleveland selects



FEATURES OF BROWN BOVERI TURBO-GENERATORS

- *High Efficiency*
- *Maximum Accessibility*
- *Compact Design*
- *Faster Starting*
- *Smooth Running*
- *Low Weight*
- *Single Oil System for lubrication and all-hydraulic governing*
- *Long Life*
- *Moderate Cost*
- *Brown Boveri Quality*

One of 3 Brown Boveri single-cylinder double-flow Turbosets operating in Isefjord Power Plant, Denmark, of the same type selected by Cleveland, to be installed in the Lake Road Generating Station, as follows:

2 Turbine-Generator Sets each 25000/31250 kw
Steam Conditions: 650 psig. 825° F Back pressure 1" Hg. abs.
Generator Voltage 11500
Frequency 60 cycles
Speed 3600 r.p.m.

Generators with built-on main and pilot exciters including automatic voltage regulators.

BROWN BOVERI CORPORATION

Progressive Engineers

SWITCHGEAR
- Air Blast Breakers
- Oil Circuit Breakers
- Power Disconnects
- High Speed DC Breakers
- Current Transformers
- Voltage Transformers

REGULATORS
- for Voltage AC and DC
- Current
- Frequency
- Power Factor
- Paper Machines
- Turbine governing

BROWN BOVERI

TURBO GENERATORS

for addition to

MUNICIPAL LIGHT PLANT

Cleveland saved nearly half a million dollars by selecting Brown Boveri Turbo-Generators . . . but it was not entirely a question of economy that dictated their choice.

Brown Boveri efficiency and reliability are known the world over. There are in the United States some 25 Brown Boveri turbo-sets, many of which have been in service for more than 20 years . . . and 14 in Canada, installed under the supervision of specialized Brown Boveri Engineers. None of these units has ever been out of operation due to lack of spare parts and service.

It will pay you to invest in Brown Boveri equipment.

A Brown Boveri Client in the USA writes:

(Jan. 7, 1949)

"We have placed, with your Company, orders for many turbogenerating units. . . . We have found your erection and service engineers highly qualified and competent men . . . even during the recent war we were able to obtain replacement parts for your machinery . . . we had confidence in obtaining these replacements as we knew you had drawings for all parts involved and same could be manufactured in this country, if not available from Switzerland."

19 Rector Street, New York 6, N. Y.

—Skilled Craftsmen—for Over 50 Years

RELAYS
- Current, Voltage, Power
- Thermal
- Differential
- Ground Fault
- Distance
- Buchholz

MOTORS AND TRANSFORMERS

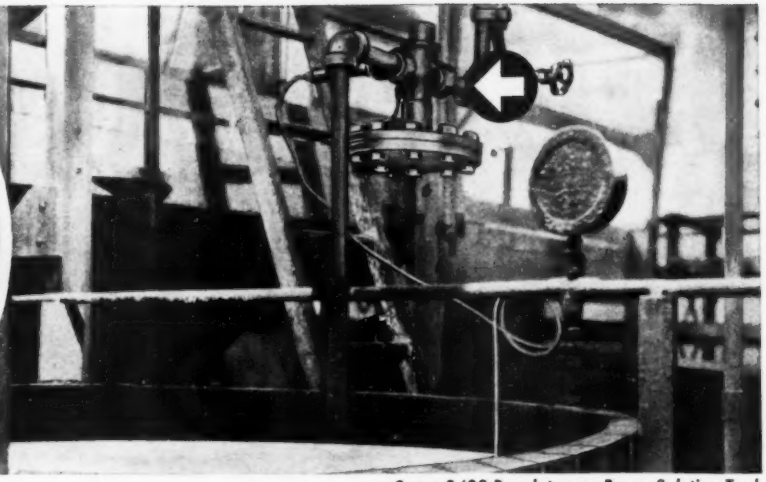
All Type Motors
- constant & variable speed

All Size Transformers
- fixed ratio & load tap changing

TURBINES
- Gas Turbines
- Steam Turbines
- Marine Turbines
- Centrifugal Compressors
- Axial Blowers
- Turbo Chargers

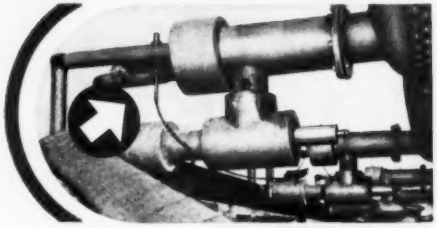
BROWN BOVERI

WHY THIS LARGE FOOD PLANT IS



Sarco 2422 Regulator on Borax Solution Tank

DEPENDING ON SARCO



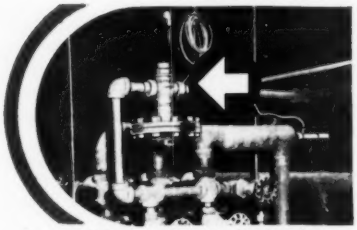
Sarco TR-21 Regulators on Oil Receiving Tanks

The public is little aware of the services rendered by the engineering departments in large industrial plants.

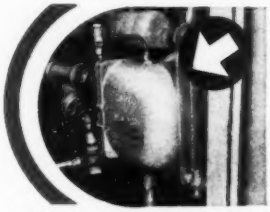
To get the last usable heat unit out of every pound of steam; to keep temperatures regulated at all points from receiving tanks to the shipping room—and to prevent the chaos that would result from the failure of any process in the plant—that is why the engineers after years of comparison, made this plant "All Sarco."

Today, more than 500 Sarco products in thirty types and sizes are used to keep this plant going right. A battery of starch driers, a group of oil tanks, various processes, extensive air conditioning and fuel oil preheat control are operational units of insured performance with Sarco Temperature Regulators.

Such engineers are the advance guard of progress in all industries using heat. The combined developments of all the plants working with Sarco Engineers is available to you. More than 100 ideas are given in the Sarco Hook-Up Book—yours on request.



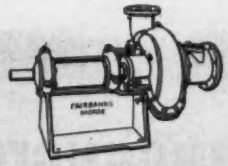
Sarco 2430 Control on Fuel Oil Preheater



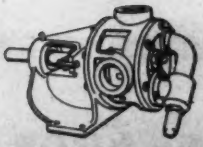
Sarco Float Thermostatic Steam Trap on Air Conditioning 234

SARCO
SAVES STEAM

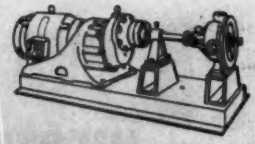
SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 3, ONTARIO



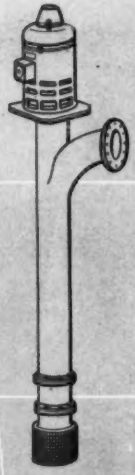
Paper Stock Pumps



Frame Constructed Rotary Pumps

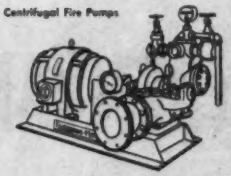


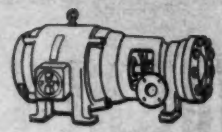
Rotary Pumps with Geared Head Motor Drive



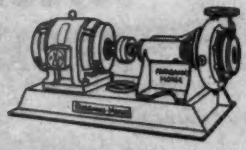
Vertical Propeller Pumps

Centrifugal Fire Pumps

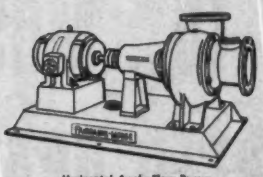




Two-Stage Bulltogether Pumps



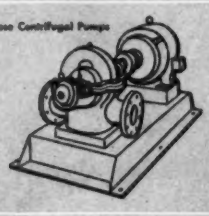
Horizontal Sewage and Trash Pumps

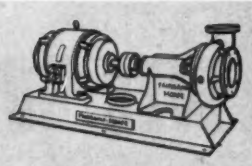


Horizontal Angle Flow Pumps

Vertical Close-Coupled Sewage and Trash Pumps

Split-Case Centrifugal Pumps

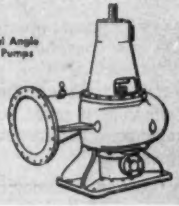


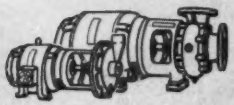


Base-Mounted Centrifugal Pumps

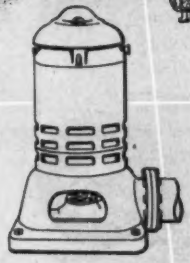
Vertical Sewage and Trash Pumps

Vertical Angle Flow Pumps

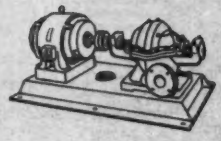




Bulltogether Centrifugal Pumps



Deep Well Turbine Pumps



Two-Stage Centrifugal Pumps

Duplex Steam Pumps

8 Cavor Side-Pot Duplex Power Pumps

for Pumps...

THAT DELIVER

plus performance
lasting dependability
unsurpassed economy

The Fairbanks-Morse Pump Dealer is your best bet for assistance in pump selection...for reliable service. Fairbanks, Morse & Co., Chicago 5, Ill.

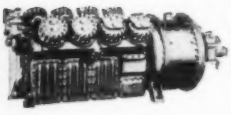
FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES • DIESEL ENGINES • PUMPS • SCALES
MOTORS • GENERATORS • STOKERS • RAILROAD MOTOR CARS
and STANDPIPES • FARM EQUIPMENT • MAGNETOS

WESTINGHOUSE ANNOUNCES THE NEW STURTEVANT TURBOVANE* 10...MOST EFFICIENT FORCED DRAFT FAN EVER BUILT

UNIT
AIR CONDITIONERS

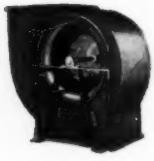


REFRIGERATION
COMPRESSORS

This is news of foremost importance to power plant operators. *No centrifugal fan has ever been built that will produce as much air power with the same power in-put as the new Sturtevant Turbovane* 10.* Up to 84% total efficiency is made possible by improved scroll design, improved inlet contour and closer manufacturing tolerances.

Look what this new efficiency can mean. A forced draft fan costing $7,000 in the course of one year's

Everything that puts air to work for Every application

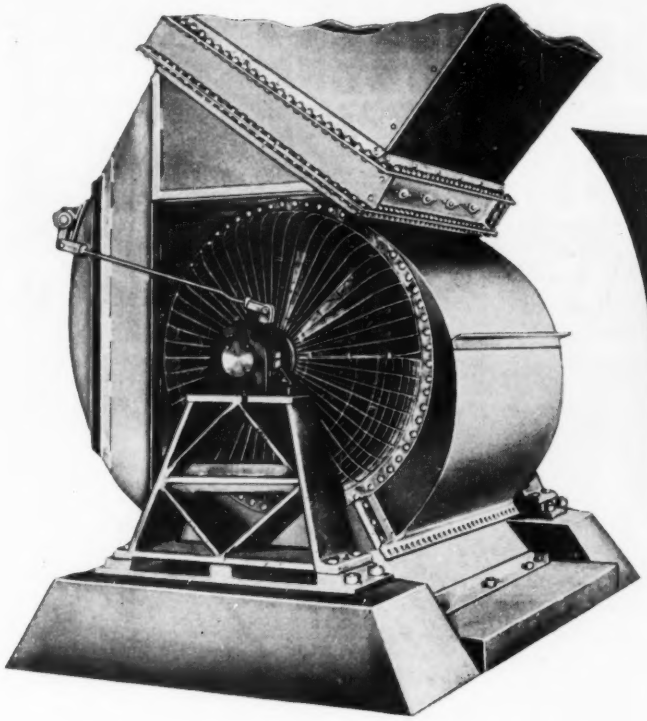


INDUSTRIAL FANS

UNIT HEATERS

VANE CONTROL*

*Reg. U. S. Pat. Off. J-80136



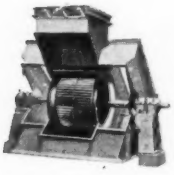
TOTAL EFFICIENCIES as high as 84%

operation may well consume $20,000 worth of electricity. That is why improved operating efficiency can show direct savings of thousands of dollars in a matter of a few years.

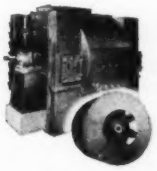
Coupled with Sturtevant Vane Control*, the new Turbovane* 10 provides the same important power economy under partial loading.

You get these new efficiencies only in the new Turbovane* 10. Call your Sturtevant office for complete information, or write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.

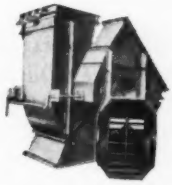
Westinghouse
Sturtevant Division



INDUCED DRAFT FANS
(Multivane*)



INDUCED DRAFT FANS
(Steel Plate)



INDUCED DRAFT FANS
(Turbovane*)

Freedom begins at home

IN America we take Freedom for granted. It is hard for us to understand why anybody would willingly give up his freedom, to live under a rule that dictates every move of his life.

Yet we must face the sobering fact that right here at home there are plenty of people who are working to curtail, and eventually to abolish personal freedom, and substitute rigid central controls over our activities. Too often these misguided groups and individuals work harder at their self-appointed tasks than do we who think we prefer freedom.

We as business men, above all others, perhaps, have a responsibility in this matter which we can ignore only at the peril of our own survival.

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON, ALLOY AND YOLOY STEELS

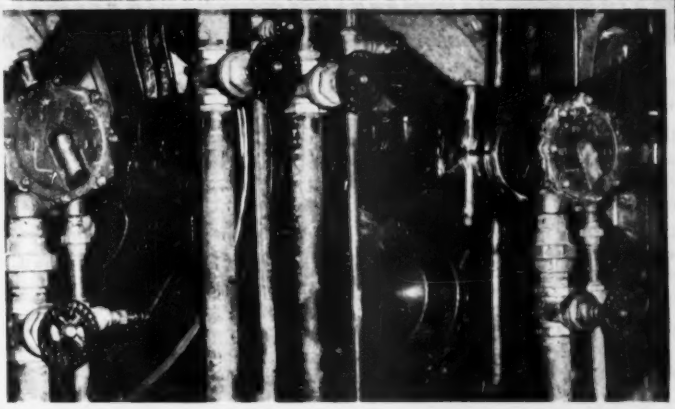
ELECTROLYTIC TIN PLATE - COKE TIN PLATE - WIRE - COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - CONDUIT - RODS - SHEETS - PLATES - BARS - RAILROAD TRACK SPIKES.

OIC VALVES
SLASH MAINTENANCE COSTS FOR SONOCO PRODUCTS CO.

In the Hartsville, S. C., plant of Sonoco Products Co., OIC Valves play an important part in the manufacture of such paper specialties as textile cones, mailing tubes, drug cans, electrical tubes, fuse tubes, spools and paper mill cores.

•

Most of the small valves shown here on a Sonoco paper machine are 2-inch size. Other OIC *Valves, in a wide variety of trims and sizes, are used on lines for such varied services as Paper Stock, Paste, Steam Power, Process Steam, Compressed Air, Water, Fuel Oil and Air Conditioning Equipment.*



SONOCO, one of the nation's leading manufacturers of paper specialties, has learned that OIC Valves cost less, over the years, than any other valves. Sonoco's own long-kept maintenance records furnish the proof!

Reasons? Plenty!

OIC Valves feature heavier construction to control pressures and stresses safely! Their streamlined design protects the flow from turbulence. Leakproof joints guard against pressure drop. Wedges of heavy I-Beam design control the flow with positive action. Integral body ribs are precision-designed — effectively reduce vibration and wear.

All these and many more outstanding features tell why Sonoco and hundreds of other leading valve users find OIC the "Pace-Setter in Valves"!

0-349-15

SEND FOR YOUR FREE COPY OF OIC'S VALUABLE VALVE CROSS REFERENCE CHART

Easy to use — saves you time and money! Simply check the number of the valve you wish to replace, look in the chart, and you'll find the right OIC valve. Write to The Ohio Injector Co., Wadsworth, Ohio for your free copy.

OIC

SETS THE PACE IN VALVES

STEEL • IRON • BRONZE

It takes POWELL VALVES *to*

complete your production picture

Everyone knows that in putting together a jig-saw puzzle picture it's simply a matter of the right piece in the right place.

In the case of flow control equipment the principle is the same. Because, only by installing the right valve—in design and material—to meet all the requirements of a specific service, can failures due to misapplication be eliminated.

Fortunately Powell *has been* applying this principle for more than a century. The result is a line of valves which is so complete that, for any set of flow control conditions encountered today, there's a Powell Valve that exactly fits all requirements.

So why not let Powell Engineers help you to complete your industrial picture by selecting valves that are specifically designed for your individual flow control services. Write us for details.

Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve with flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc. Disc, when wide open, permits full, unobstructed flow through valve body.

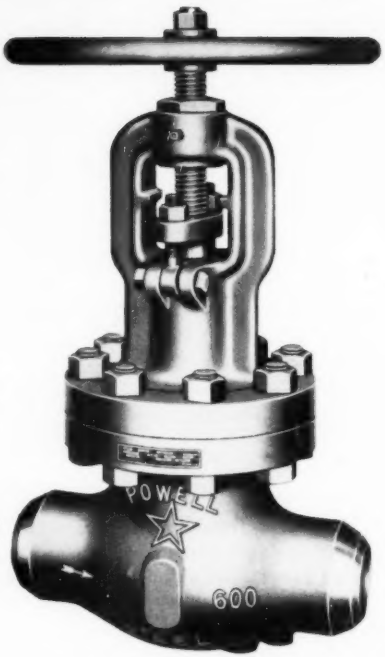


Fig. 6031 W.E.—Class 600-pound Cast Steel Globe Valve with welding ends, outside screw rising stem and bolted flanged yoke.

POWELL

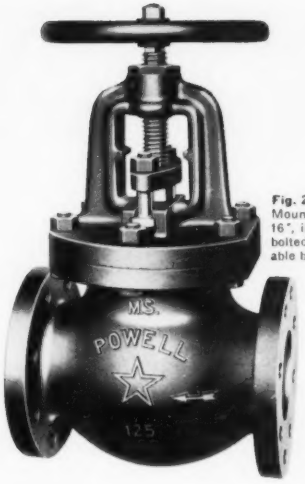


Fig. 241—Large 125-pound Iron Body Bronze Mounted Globe Valve. Made in sizes 2" to 16", inclusive. Has outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc.

Fig. 3061 W. E.—Class 300-pound Cast Steel Swing Check Valve with welding ends and bolted cap. Disc has ample lift to permit full straightway, unobstructed flow through the valve body.

Fig. 375—200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable wear-resisting "Powellium" nickel-bronze disc.

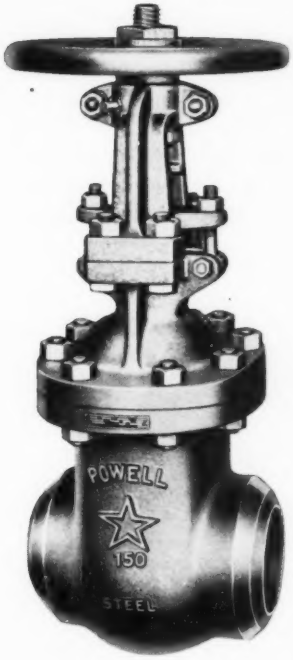


Fig. 1503 W. E.—Class 150-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

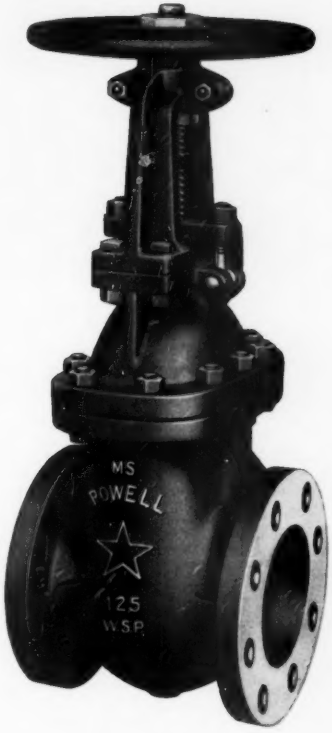


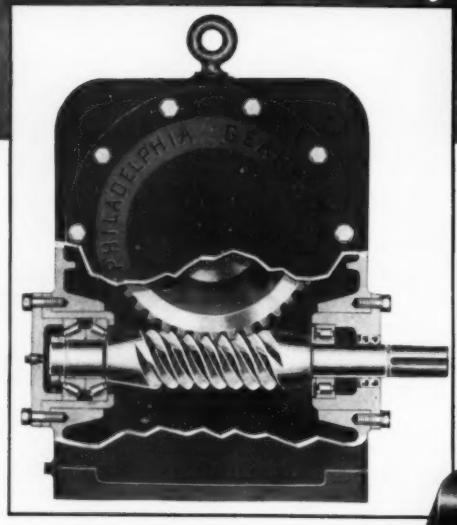
Fig. 1793—125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", incl. Has outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Taper wedge double discs can be provided in sizes 2" to 12", incl.

The Wm. Powell Company, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

VALVES

WHAT MAKES A *Good* WORM GEAR SPEED REDUCER?



Any Speed Reducer is only as good as the *experience* and the *manufacturing facilities* of its manufacturer . . . These factors, plus world-wide acceptance of Philadelphia Worm Gear Reducers, pre-supposes that these units must be *efficient, rugged and as trouble-free as possible.* In fact, Philadelphia Worm Gear Reducers embody every known mechanical feature that can be considered important for the efficient transmission of power, under all conditions. We offer every type, size and reduction ratio of Worm Gear Speed Reducer.

FEATURES . . .

OF THE TYPE A - T - O AND R - T - O PHILADELPHIA WORM GEAR SPEED REDUCERS

May be had with Worm Gear "above" or "below" the Worm Wheel;

Worms are made of alloy steel with carburized, hardened and tempered threads—both shaft and threads are accurately and smoothly ground after heat-treatment;

Worm Wheels (or Rims) are of highest quality chill cast nickel-bronze;

Bearings are anti-friction types (ball or roller) best suited for smooth, quiet, trouble-free operation (see cut-away illustration);

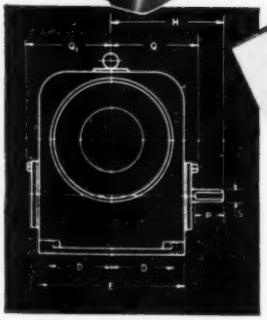
Housings are of "one-piece," quality grey iron—compact, neat, rigid and of ample radiating surface to prevent overheating;

All units carry A. G. M. A. ratings;

Easy accessibility for removal of either Worm or Worm Wheel assemblies, from the one-piece housing;

Lubrication by splash system to all moving parts, in oil-tight housing;

Efficiencies as high as 90%.



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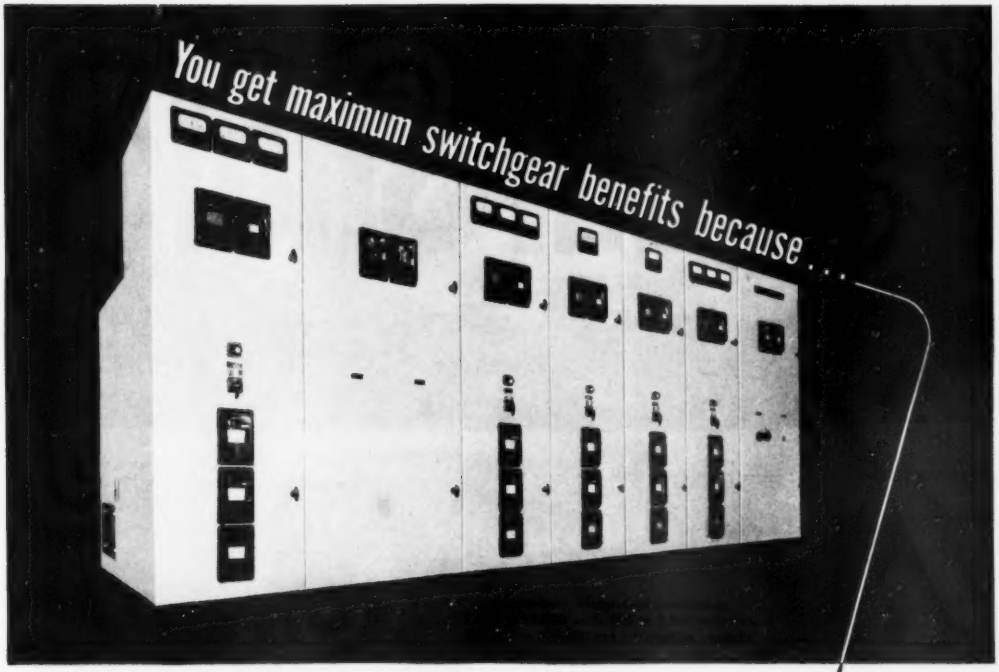

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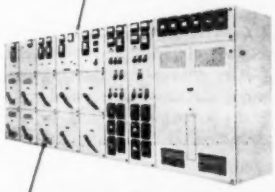

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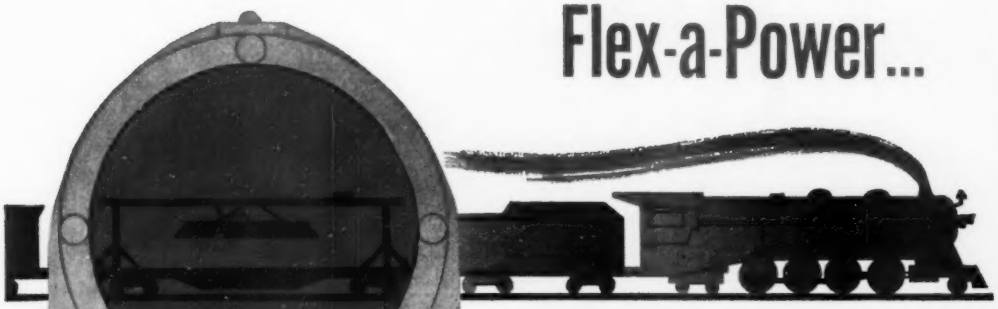

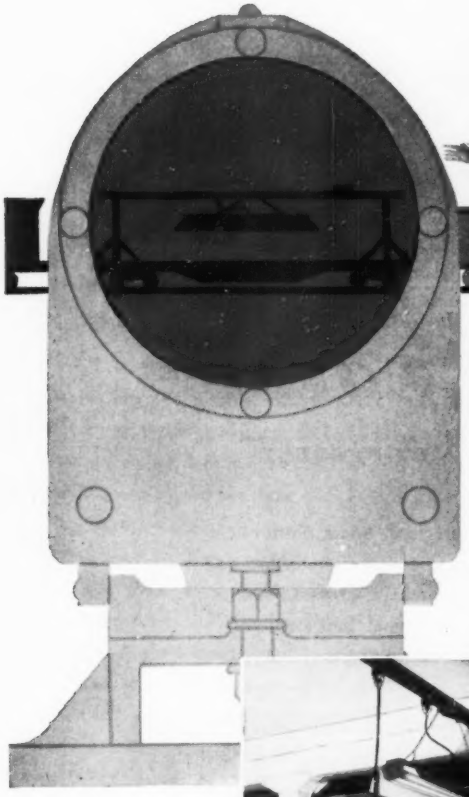

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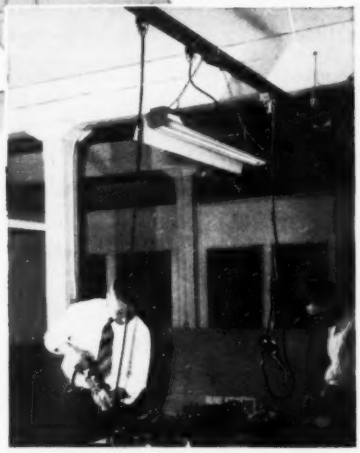

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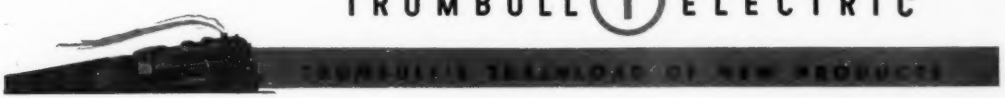

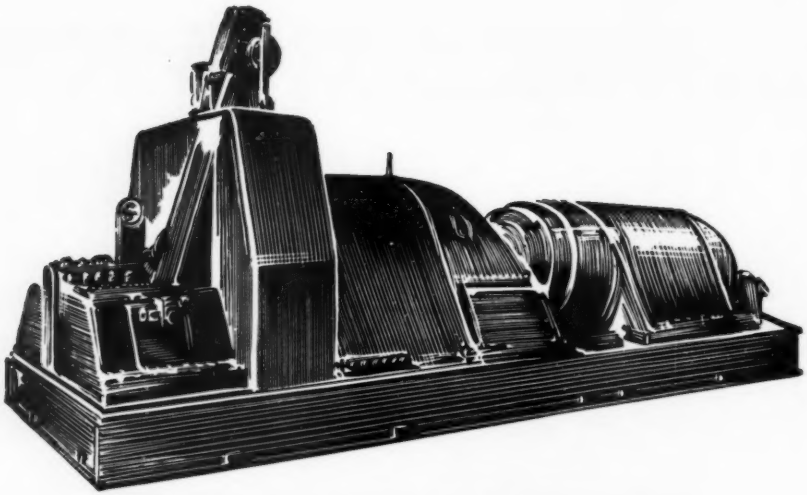

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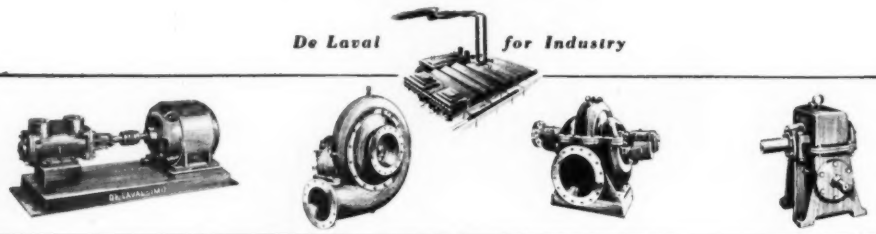

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APRIL 1949 **VOLUME 93, NUMBER 4**

A CROSS-INDEX OF SUBJECTS FOR THE MONTH

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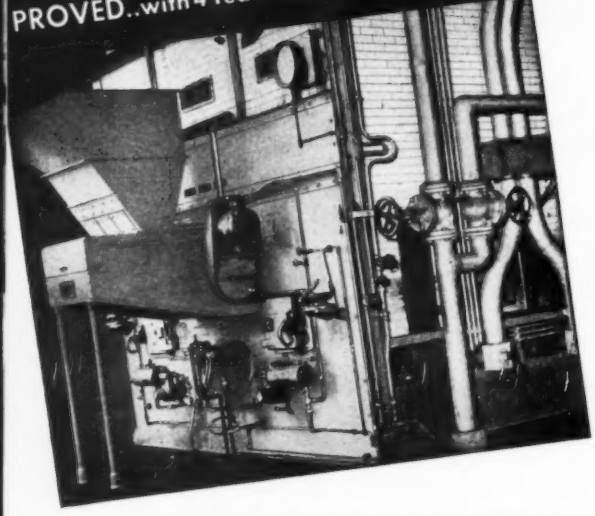

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Every point of Centrafire's superiority is proved: high thermal efficiency; maximum fuel combustion; continuous, even coal feed and distribution; economical firing of any grade coal; ash discharged without reducing capacity.

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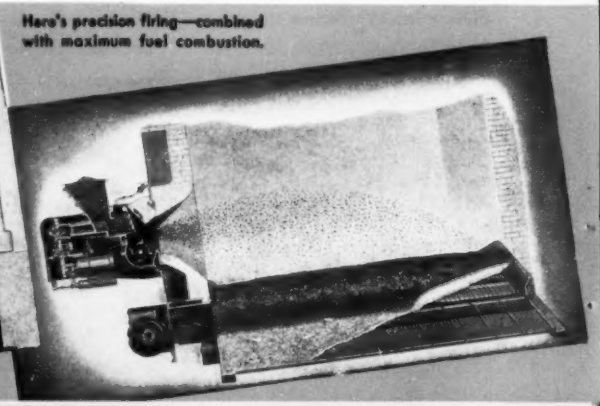
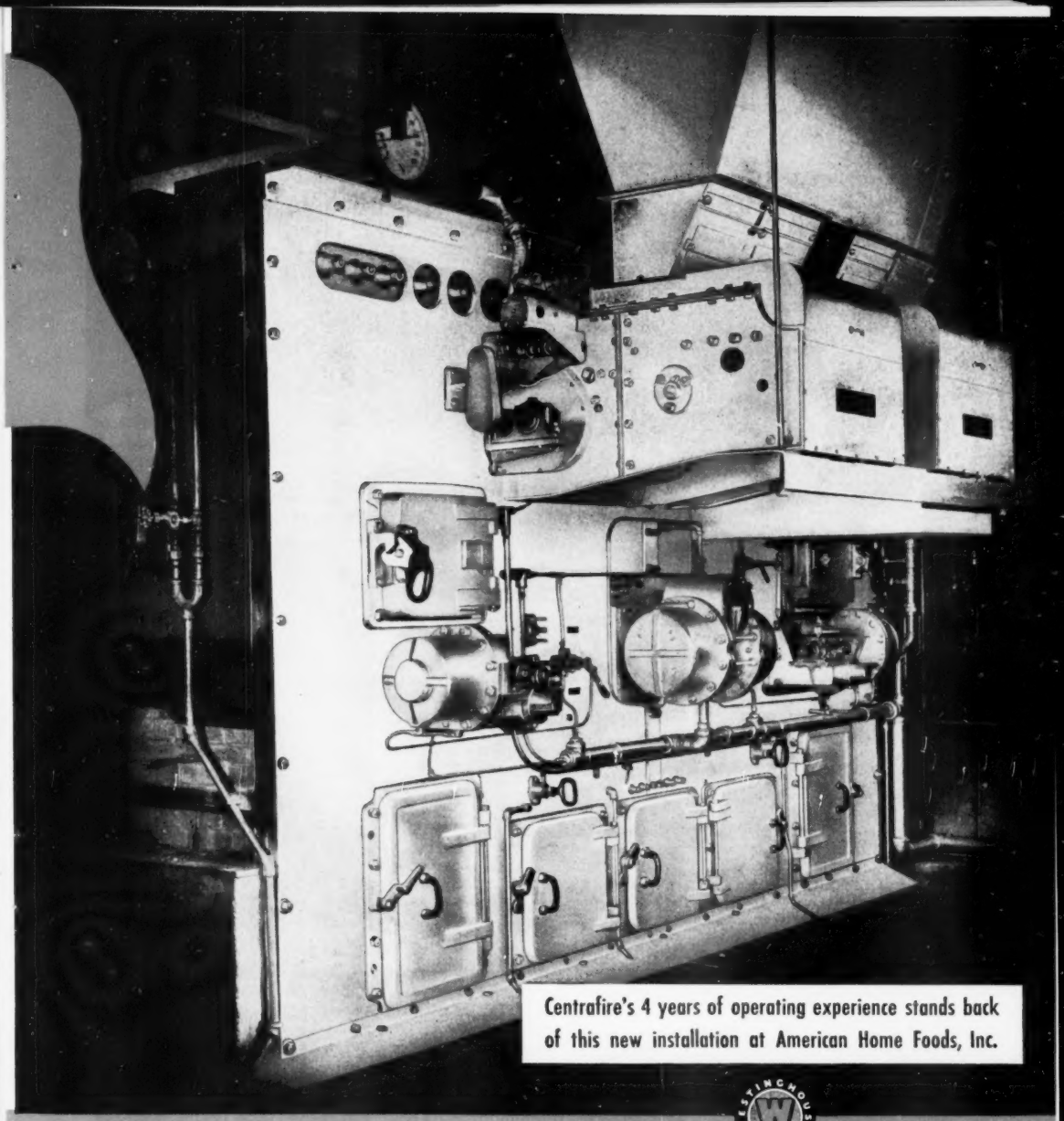


Here's precision firing—combined with maximum fuel combustion.



Centrafire's 4 years of operating experience stands back of this new installation at American Home Foods, Inc.

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This informative booklet tells the full story of Centrafire . . . in glowing colors. It shows exactly how Centrafire, with the famous Link-Grate, achieves high thermal efficiency and maximum fuel combustion. Write for your free copy. Ask for B-3990. J-50484-A

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with the famous Link-Grate

SOIL AND WATER BOTH CORROSIVE—

so underground steam line replacements are

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Spread over almost 20 square miles, the Agricultural Research Center occupies one of the largest areas in the world devoted to research on better farming and farm living. The physical plant includes thirty-six laboratory buildings, thirty-one greenhouses, one hundred barns and storage buildings, five hundred small-animal and poultry houses, plus miscellaneous structures. Heat, supplied by a central power plant, is distributed through an extensive underground system.

Both the soil, and the water—supplied from a brackish swamp—are highly corrosive, so that the maintenance of the piping system has been a problem. Wrought iron has been extensively used in replacements. The illustration at right shows part of three 2000-foot runs of Byers Wrought Iron pipe recently installed between the steam plant and the Administration Building. The 6-inch supply line, the 2-inch vacuum return, and the 1½-inch high pressure return, all wrought iron, are installed in a concrete tunnel with a slab top.

The ability of wrought iron to resist the severe corrosive conditions usually present in underground installations has been confirmed many times, over long periods of years. One example comes from Illinois, where a ten-inch wrought iron underground steam line was installed years ago. At last report, made after 39 years of continuous service, the line was still operating . . . and had required no maintenance whatsoever.

Wrought Iron's unusual resistance to corrosion comes from its unusual composition and structure. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and "detour" corrosive attack, and so discourage pitting. The fibers also anchor the initial protective scale, which shields the underlying metal.

The complete story of what wrought iron is, how it is made, and where it is used is condensed in a booklet, "THE ABC'S OF WROUGHT IRON". We will be happy to send you a copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco. Export Division: New York, N. Y.

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POWER

PHILIP W SWAIN, EDITOR • APRIL • 1949 • ESTABLISHED IN 1882

Engineers of Tomorrow

THE FUTURE of technical America will be largely in the hands of engineers who are now high-school boys. Our national welfare demands not only that these youngsters be well trained in our engineering schools, but even more that they be well selected.

Good training is largely wasted if the wrong men get into the profession or the right men stay out. Another appalling waste is the 60 percent who start to study engineering but never finish.

We have no way to tell how many men who ought to be engineers are doing other work, but there must be many such, for guidance has been largely left to chance. Why should older engineers—and the colleges—assume that the high-school boy knows enough about our profession to make a sensible choice? Too much is left to guesswork and fuzzy impressions.

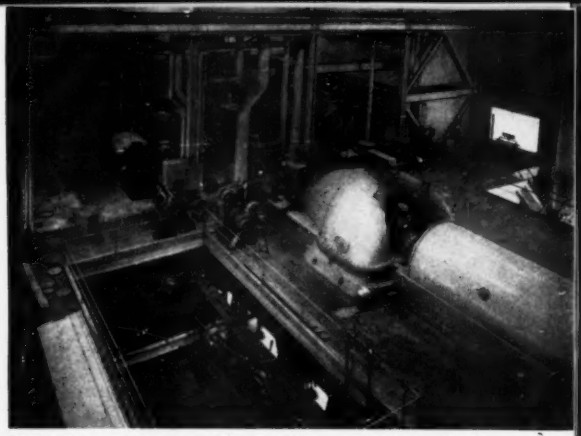
Now what can we do to stop this waste of human effort and this national loss of professional skill? First, many other communities should follow the constructive lead of the New York Engineers Committee for Student Guidance. For twelve years now, practicing engineers in the metropolis have been sitting down with groups of high-school boys to explain their profession and answer all questions. In this way, experienced engineers are helping to "reseed" the new crop that will manage the technology of tomorrow.

The colleges, too, could do more to guide the young hopefuls into fruitful paths. A superb example of what can be done is *Careers in Engineering and Science*, recently issued by the Polytechnic Institute of Brooklyn, N. Y. This helpful book bears little resemblance to the cut-and-dried college catalog. It faces up to the fact that its young readers cannot intelligently select a college, an engineering course, or even this profession, until they first know what engineering is and what it takes to succeed in it.

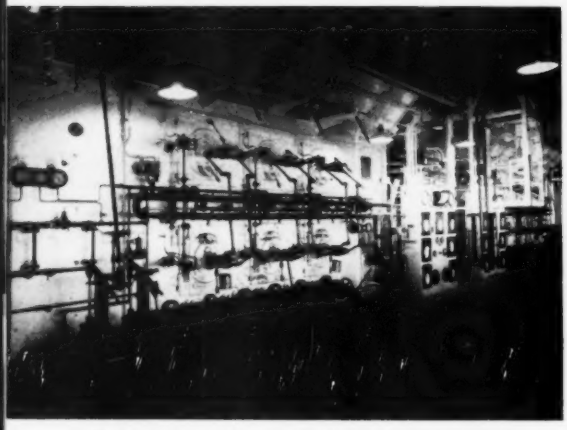
We commend "Careers" to the attention of engineering faculties everywhere, as an example that should be widely followed. And we commend it to all young men who seek intelligent guidance into the engineering field, or away from it.

Finally, we urge mature engineers everywhere to give more time to the young fellows, answering their eager questions about the profession and giving them a much needed straight steer.

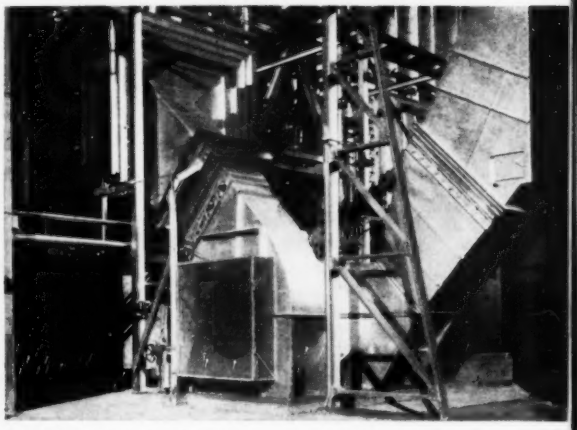
1 Kern Steam Plant with first unit completed. Cooling towers in foreground, outdoor boilers under canopy, at right



2 60,000-kw Unit No. 1 has its house unit, boiler feed pumps, evaporators and heaters on common operating floor



5 Burner fronts of boilers No. 1 and 2 are on common operating level. Note movable burner-maintenance platform, right



6 Outdoor forced-draft and induced-draft fans are driven by common 2000-hp 2300-v motor at approximately 700 rpm

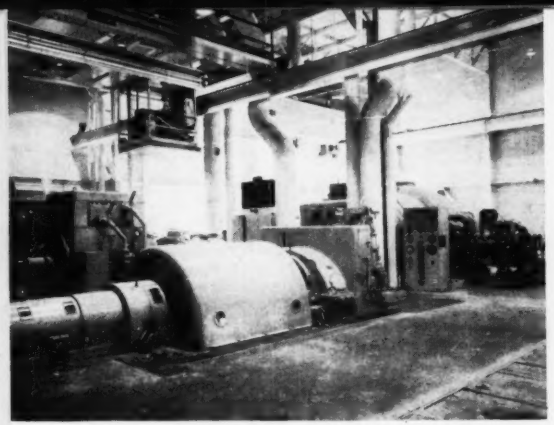
Kern Steam Plant Uses Cooling Towers

Fast load-pickup requirement leads to all electrically driven auxiliaries, house turbine-generator, central control room, high steam pressure, two boilers per main turbine. Semi-outdoor design places boilers and fans outdoors with completely enclosed boiler-firing aisle on operating-floor level

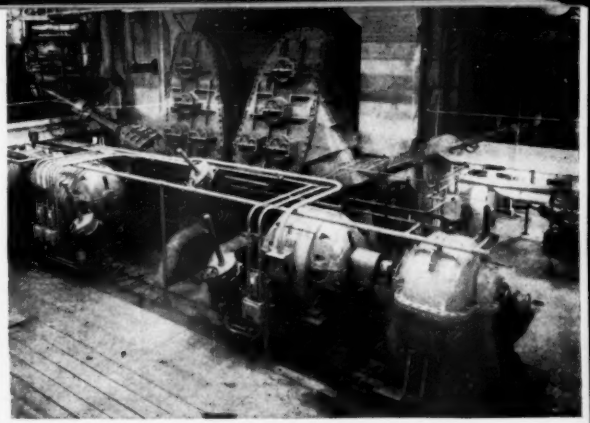
► ONE OF THE FIRST UNITS to operate in the Pacific Gas & Electric Co's current gigantic expansion program is No. 1 at the new Kern Steam Plant. This plant, about 4 miles west of Bakersfield, Calif., started in May 1948, and ties into the southern end of the extensive system. At this time the major share of system capacity is in hydro plants that operate to make best use of available water. Accordingly, Kern will operate at low load sometimes but may be called on for full-load production within a matter of 20 to 30 seconds.

This condition exerts a major influence in equipment selection: two steam generators are better than one, fairly high pressure of 1350 psig is more favorable than a lower pressure, attemperators in lower boiler drums help prevent excessive thermal shock on turbines. Forced-draft and induced-draft fans as well as boiler feed pumps operate at full speed at all times, ready for full loading. Oil and gas are the fuels, the latter being burned when available. Fuel burners have a capacity range of 20:1, and all of them are always in operation.

Main Equipment. Unit No. 1 will have two radiant-type boilers normally rated at 450,000 lb per hr with maximum steaming capability of 517,500-lb-per-hr supply steam at 1350 psig and

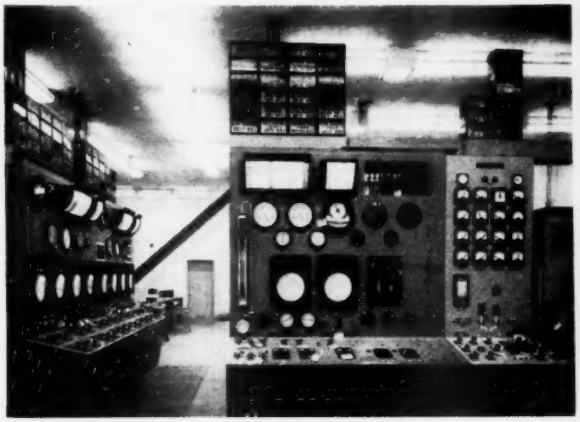


3 House unit is driven by 6000-kw single-automatic-extraction condensing turbine, picks up auxiliaries in emergency



4 Main unit condenser has 35,000 sq ft of heat-transfer surface, is served by two 32,500-gpm circulating-water pumps

7 Controls for Kern station are concentrated in one room on operating-floor level; annunciator indicates trouble point



8 Boiler and turbine-generator control panels in central-control room keep operator informed of equipment condition

For Main Circulating-Water Supply

925 F to a 60,000-kw 75,000-kva turbine-generator and a 6000-kw single-automatic-extraction condensing house turbine-generator.

Unit No. 2, now under construction, will have two steam generators duplicating those of No. 1 that supply one 100,000-kw main unit and a 7500-kw house unit. Three of the four steam generators will be able to develop the total station output.

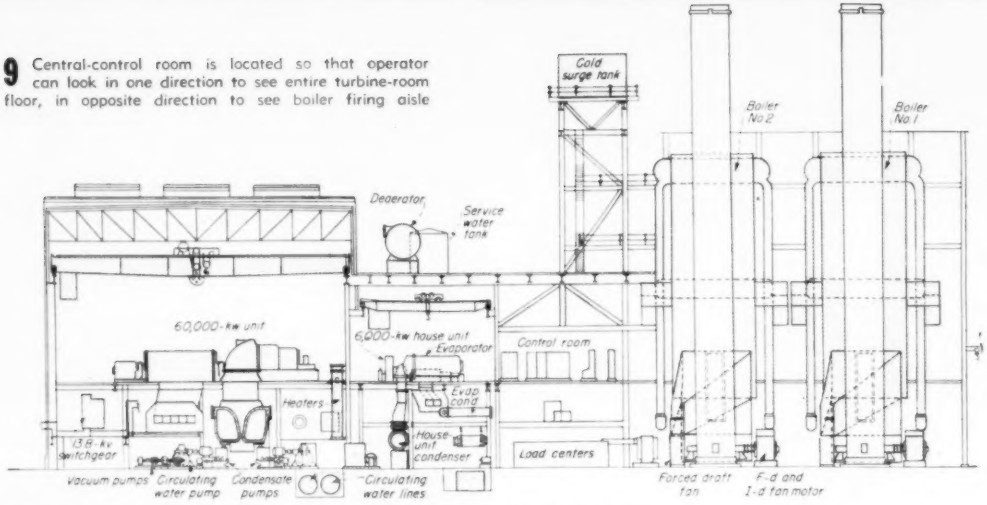
No. 1 main turbine, of single-casing design, has four bleed points, operates at 1800 rpm and exhausts at 3 in. Hg abs. It drives an air-cooled generator. The 35,000-sq-ft surface condenser has a single water pass with divided water boxes and center steam space. Condensate collects in a deaerating, storage hotwell. The 2 twin-element 2-stage steam-jet air ejectors are supplemented by two mechanical-type vacuum pumps having a capacity of 320 cfm each.

Under normal operation, the 3600-rpm house unit floats on the line carrying whatever load the 20-psia extraction steam to the deaerator develops, Fig. 11. In event of an electrical-system disturbance the house generator automatically isolates from the main bus and picks up the entire station auxiliary load instantly. Tests have shown the unit capable of starting from cold standstill and carrying full load at full speed within 20 seconds total time.

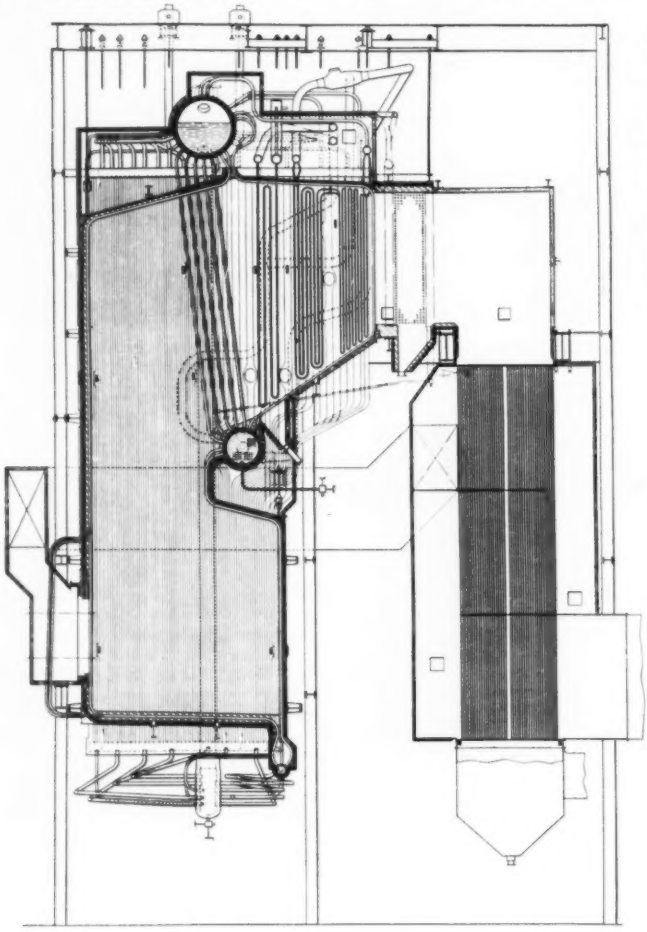
Steam Generator. Automatic combustion control supervises steam generator operation. Fuel-oil and gas control valves operate in parallel. Oil burners retract into the furnace wall with increasing load demand. The oil-burner retractor drive operates in parallel with the fuel-oil control valves. Bypass valves for both oil and gas burners maintain proper pressures. Varying speed and operation of motor-driven primary oil pumps control the fuel-oil feed pressure, Fig. 12.

Controller *a* operates between 660 and 650 psig. Pressure in header 1 starts to drop with increasing boiler

9 Central-control room is located so that operator can look in one direction to see entire turbine-room floor, in opposite direction to see boiler firing aisle



10 Radiant boilers, below, 450,000 lb per hr normal can burn either oil or gas in six combination burners. Economizer is followed by tubular-type air heater



demand and recirculating control valve *A* begins to close. When it nears fully closed position the limit switch operates a drum sequence controller, which increases pump speed or starts another pump to supply additional oil demand. If header pressure does not return to normal a third pump starts, and so on.

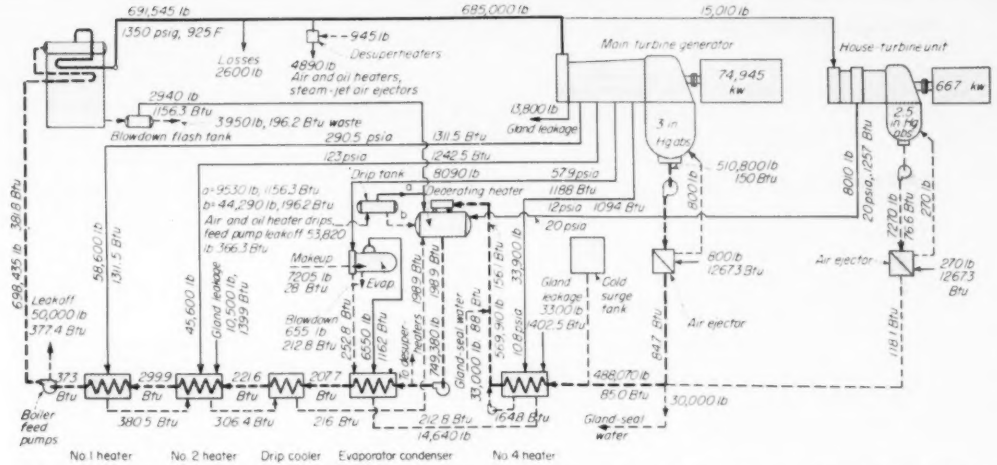
With decreasing boiler load, control valve *A* opens, spilling excess oil to pump suction. When valve nears fully open position, limit switch operates drum controller to reduce speed or take pumps off the line in reverse sequence.

If motor-driven pumps do not supply enough oil to maintain header pressure above 645 psig, pressure switch *d* opens steam valve *D* through selector valve *F*, normally set in automatic position. Simultaneously, controller *c* on header *1* set at 645 psig, opens control valve *C* to connect turbine-driven pump to the header.

Under normal operation the turbine-driven pump may be used to recirculate the oil for warming purposes at the tanks. Hand-operated bypass valve *E* runs the turbine-driven pump at the speed needed for recirculation. To keep high pressure at the pump discharge so it can be used immediately on the main header when needed, pressure controller *b* operates valve *B* to maintain 655 psig.

When valve *C* opens during recirculating periods the resulting pressure drop of the turbine-driven pump discharge causes valve *B* to close off the recirculating flow, making full pump capacity available on the main header.

To place the pumps in operation automatically the $\frac{3}{4}$-in. warming lines are partially opened on standby pumps. This introduces warm h-p oil from header *1* between the standby pump and its discharge check valve and the



11 During normal operation house turbine floats on line supplying major part of heating steam to deaerator and passing cooling steam to its condenser. Cold surge tank stores condensate for sudden load changes, note b-f pump position

pump slowly turns in reverse rotation.

To control recirculation by the turbine-driven pump from the control board, selector valve *F* may be set in manual position. In this case automatic control of turbine pump speed will not be available till selector is returned to automatic position.

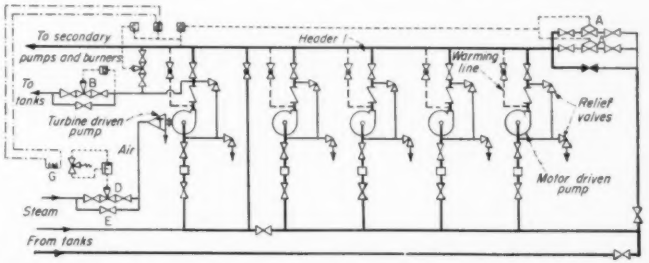
The combustion-control system is arranged so that the forced-draft fan control regulates in parallel with that for the fuel. The induced-draft fan control works in parallel with that for the f-d fan.

Two attemperators in the lower boiler drum regulate steam temperature. During normal operation attemperator control responds to steam temperature corrected by an air-flow factor. On low load the air-flow factor does not operate.

Plant Layout. Fully automatic control minimizes manual attention during rapid load pickups, as well as reducing the staff needed for operation. Lowest operating floor is 1 ft above ground level, perfectly uniform to give a "billiard table" design, Fig. 9. The main operating floor, 26 ft higher and also at a uniform level, carries through from turbine room, to auxiliary bay, to control room, and finally to boiler-firing aisle.

The turbine room, auxiliary bay and central-control room are completely housed because of dust storms and

(*Continued on page 162*)



12 Primary fuel-oil pumps are automatically controlled so that they cut in and out of service in response to changes in boiler loading over very wide range

PRINCIPAL POWER-PLANT EQUIPMENT

No. 1 Unit, Kern Steam Plant, Bakersfield, Calif., Pacific Gas and Electric Company

STEAM-GENERATING EQUIPMENT

Boilers, 2 ..... Babcock & Wilcox Co
450,000 lb per hr, normal rated, 517,000 lb per hr maximum capability 1380 psig, 935 F at superheater outlet, radiant, single pass, 5122-sq-ft effective heating surface, 18,350-cu-ft furnace volume, 4350 sq ft effective waterwall surface

Superheaters, 2 ..... Babcock & Wilcox Co
Pendant, two sections, bottom-drum attemperator, 14,968 sq ft heating surface, attemperator heating surface—680 sq ft

Control and safety valves ..... Manning, Maxwell & Moore, Inc

Soot blowers ..... Diamond Power Specialty Corp

Economizer, one per boiler ..... Babcock & Wilcox Co
Tubular, 6879-sq-ft heating surface, horizontal, counterflow

Fuel-oil pump, recirculating, 1 ..... Sier-Bath Gear & Pump Co
28,000 lb per hr, internal-gear type

Recirculating fuel-oil pump drive ..... General Electric Co
60 hp, single-stage steam turbine, 4000 rpm

Oakite tank, 1 ..... McDonough Steel Co
700-gal capacity, for fuel system cleaning

Oakite pump, 1 ..... Ingersoll-Rand Co
200 gpm at 1750 rpm, driven by 7½-hp motor

Forced-draft fan, 1 per boiler ..... American Blower Corp
Single inlet, on same shaft with i-d fan, 700,000 lb per hr at 25-in. water, 105 F, 698 rpm

Air heater, one per boiler ..... Babcock & Wilcox Co
Tubular, one air pass, three gas passes, 67,600-sq-ft surface

Steam air heaters, 2 ..... Aerofin Corp

Fuel burners, 6 per boiler ..... Peabody Engineering Co
Constant-differential pump type, combination oil and gas, horizontal firing, front wall, 36,200 to 1800 gpm oil-flow range, 11,800 to 590 cfm gas-flow range, one electrically ignited gas-fired torch per burner, manually operated

Fuel oil pumps, primary, 4 ..... Sier-Bath Gear & Pump Co
Internal-gear type, 28,000 lb per hr each

Primary fuel-oil pump drive, 4 ..... Reliance Electric & Engineering Co
60 hp, 1150 rpm, 440 v, squirrel cage

Fuel-oil pumps, secondary, 4 ..... United Iron Works
75 gpm at 300-psi differential, 4 stage, driven by 40-hp motors at 3500 rpm

POWER-PLANT EQUIPMENT *CONTINUED*

Induced-draft fan, 1 per boiler ..... American Blower Corp
Double inlet, on same shaft with f-d fan, 810,000 lb per hr at 13.5 in. water, 698 rpm
Fan drive, 1 per boiler ..... General Electric Co
2000 hp, 2300 v, electric motor
Steel stack, 1 per boiler ..... California Steel Products Co

FEEDWATER EQUIPMENT:

Closed feedwater heaters, 4 ..... Foster Wheeler Corp
No. 4—vertical, 545 arsenical-cu tubes, −14.7 to 50-psig shell pressure, 150-psig tube pressure, 5 F terminal diff
No. 3—vertical, 680 80/20 Cu-Ni tubes, 300-psig shell pressure, 600-psig tube pressure, 6.9 F terminal diff
No. 1—vertical, 580 80/20 Cu-Ni tubes, 400-psig shell pressure, 600-psig tube pressure, 7 F terminal diff
Drain cooler—horizontal, 366 80/20 Cu-Ni tubes, 300-psig shell pressure, 600-psig tube pressure, 10 F terminal diff
Deaerating heater and vent condenser ..... Elliott Co
50-psig working pressure, 589,000 lb per hr condensate entering, 827,700 lb per hr feedwater leaving
Evaporator and evaporator condenser ..... Foster Wheeler Corp
Two units can be operated as double-effect unit, 730 sq ft each evaporator, 625 sq ft condenser surface
Boiler feed pumps, 3 primary ..... Ingersoll-Rand Co
575,000 lb per hr at 500 psi, 228 F, 4 stages, common driver with secondary pumps
Boiler feed pumps, 3 secondary ..... Ingersoll-Rand Co
575,000 lb per hr at 1400 psi, 400 F, 7 stages
Boiler feed pump drives, 3 ..... General Electric Co
2000 hp, 2300 v, constant speed at 3570 rpm
Distilled-water pumps, 3 ..... Ingersoll-Rand Co
225 gpm at 3450 rpm, 150-ft normal dynamic head
Distilled-water pump drives, 3 ..... Westinghouse Electric Corp
15 hp, 440 v, squirrel cage, splashproof motors
Evaporator feed pumps, 3 ..... Ingersoll-Rand Co
55 gpm at 3450 rpm, 113-ft head
Evaporator feed pump drives, 3 ..... Westinghouse Electric Corp
3 hp, 440 v, squirrel cage, splashproof motors
General-service-water pumps, 2 ..... Ingersoll-Rand Co
250 gpm at 3450 rpm, 155-ft dynamic head
Service-water pump drives, 2 ..... Westinghouse Electric Corp
20 hp, 440 v, squirrel-cage motors, splashproof
Sealing-water pumps, 2 ..... Ingersoll-Rand Co
100 gpm at 3450 rpm, 155-ft normal dynamic head
Sealing-water pump drive, 2 ..... General Electric Co
10 hp, 440 v, squirrel-cage motor, splashproof
No. 4 heater drip pump, 2 ..... Ingersoll-Rand Co
300 gpm at 1740 rpm, 155-ft dynamic head
Heater drip pump drives, 2 ..... Westinghouse Electric Corp
20 hp, 440 v, splashproof, squirrel-cage motors
Closed drip-tank pumps, 2 ..... Ingersoll-Rand Co
263 gpm at 1750 rpm, 125-ft dynamic head
Drip-tank pump drives, 2 ..... Westinghouse Electric Corp
15 hp, 440 v, splashproof, squirrel-cage motors
Closed system bearing cooling-water pumps ..... Ingersoll-Rand Co
500 gpm at 3450 rpm, 150-ft dynamic head
Bearing cooling-pump drives, 2 ..... Westinghouse Electric Corp
30 hp, 440 v, splashproof, squirrel-cage motors
Boiler-water transfer pumps, 2 ..... Ingersoll-Rand Co
400 gpm at 3450 rpm, 125-ft dynamic head
Transfer-pump drives, 2 ..... Westinghouse Electric Corp
25 hp, 440 v, squirrel-cage motors
Boiler wash pump ..... Ingersoll-Rand Co
Boiler wash-pump drive ..... Westinghouse Electric Corp
Boiler test pump ..... Worthington Pump and Machinery Corp
Test pump drive, 15-hp gearhead motor ..... General Electric Co
Miscellaneous water tanks ..... American Pipe & Steel Co; Lacy Manufacturing Co; Missouri Boiler & Sheet Iron Works; Western Pipe & Steel Co; Walter R Cole Co
Sealing-water heat exchangers ..... Ross Heater & Manufacturing Co

POWER-GENERATING EQUIPMENT:

Turbine-generator ..... General Electric Co
60,000-kw rating, 75,000-kva maximum, single casing, single flow, four bleed points, 1350 psig, 925 F, 2.75 in. Hg abs, 1800 rpm, 13,800 v, 3 phase, 60 cycle, 0.8 pf, air cooled, direct-connected 210-kw main exciter, direct-connected 4-kw pilot exciter, turning gear, oil and air coolers
House turbine-generator ..... General Electric Co
6000-kw rating, 7500-kva maximum, automatic extraction admission condensing, 1325 psig, 925 F at throttle, 5-psig admission extraction, 2.5 in. Hg abs, 2400 v, 3 phase, 60 cycle, 0.8 pf, 3600 rpm direct-connected main and pilot exciters, air cooled
Main unit condenser ..... Foster Wheeler Corp
35,000 sq ft surface, cross flow, 5900 tubes
Main circulating-water pumps, 2 ..... Foster Wheeler Corp
Single stage, horizontal, 32,500 gpm at 55-ft dynamic head
Circulating pump drives, 2 ..... General Electric Co
600 hp, 2300 v, squirrel cage, splashproof
Main condensate pumps, 2 ..... Foster Wheeler Corp
3-stage, horizontal, 1200 gpm at 185-ft head
Condensate-pump drives, 2 ..... Continental Electric Co
100 hp, 440 v, squirrel-cage motors, splashproof
House unit condenser ..... Foster Wheeler Corp
Single pass, reverse flow, 4000 sq-ft surface
House condenser circulating-water pump ..... Foster Wheeler Corp
Single stage, horizontal, 9000 gpm at 51.5 ft head
Circulating pump drive ..... Continental Electric Co
150 hp, 2300 v, 705 rpm
House unit condensate pumps, 2 ..... Foster Wheeler Corp
Two-stage, horizontal, 170 gpm at 185-ft head
Condensate pump drives, 2 ..... Continental Electric Co
20 hp, 440 v, 1750 rpm
Vacuum tank ..... Steel Tank & Pipe Co of California
30 in. Hg vacuum to 50 psig
Vacuum pumps, two, 320 cfm ..... Nash Engineering Co
Vacuum pump drives, two, 20 hp, 900 rpm ..... General Electric Co
Vacuum pump, 90 cfm ..... Nash Engineering Co
Vacuum-pump drive, 7½ hp, 1200-rpm motor ..... Hartman Corp of America
Lubricating-oil storage tank ..... Lacy Manufacturing Co
Lubricating-oil filters, 2 ..... Bowser Inc
Lubricating-oil pumps, 4 ..... Quimby Pump Co
Portable oil purifier, 300 gph ..... De Laval Separator Co

INSTRUMENTS AND CONTROLS:

Control boards ..... Bailey Meter Co; G & N Engineering Co; General Electric Co
125-v dc switchboard ..... Westinghouse Electric Corp
Current limiting reactors, 3 ..... General Electric Co
Throwover circuit breakers, 17 ..... Square D Co
Terminal boxes, 56 ..... Northeastern Engineering Co, Inc
Combustion control ..... Bailey Meter Co
Boiler feed control ..... Bailey Meter Co
Load-frequency control ..... Leeds & Northrup Co

MISCELLANEOUS EQUIPMENT:

Piping fabrication and erection ..... Midwest Piping & Supply Co
Steel circulating-water piping ..... California Steel Products Co
Concrete circulating-water piping ..... American Pipe Co
Valves, all types ..... The Chapman Valve Manufacturing Co; Edward Valves, Inc; Atwood & Morrill Co; Crane Co; Manning, Maxwell & Moore; Walworth Co; General Machinery & Supply Co; Reading, Pratt & Cady Div; Mason-Neilan Regulator Co; Bethlehem Supply Co; Ruggles-Klingemann Manufacturing Co; A D Darragh & Co
Deepwell pump, 1500 gpm ..... Wintroath Pumps, Inc
Deepwell pump drive, 100-hp 440-v motor ..... General Electric Co
Shallow-well pump, 1500 gpm ..... Wintroath Pumps, Inc
Shallow-well pump drive, 100 hp, 440-v motor ..... General Electric Co
Main cooling tower, 2 ..... Foster Wheeler Corp
Forced draft, 259,000,000 Btu per hr dissipation
Auxiliary cooling towers, 2 ..... Foster Wheeler Corp
Induced draft, 12,000,000 Btu per hr dissipation
Heat exchangers, service water, 2 ..... C F Braun Co
Auxiliary cooling-tower pumps, 2 ..... Ingersoll-Rand Co
Aux cooling-tower pump motors, 2 ..... Hartman Corp of America
Hot process for evaporator feed ..... Infilco, Inc
Chemical feed pumps, 3 ..... Ingersoll-Rand Co
Glassy sodium phosphate for condenser cooling water ..... Infilco, Inc
Phosphate suction pumps, 3 ..... Milton Roy Co
Condenser-water chlorinating units, 3 ..... Wallace & Tiernan Co
Chlorinating-water pumps, 2 ..... Ingersoll-Rand Co
Chlorinating-pump drives, 2 ..... General Electric Co
Fuel-oil heaters, primary, 2 ..... The Griscom-Russell Co
Fuel oil heaters, secondary, 3 ..... Ross Heater & Manufacturing Co
Fuel meters, oil and gas ..... Bailey Meter Co
Gas-line separator, 1 ..... McDonough Steel Co
Turbine-room crane, 100 ton, 25-t aux ..... Judson Pacific Co
Auxiliary bay crane, 20 ton, machine-shop crane ..... Whiting Corp
Draft-fan crane, 10 ton ..... Harnischfeger Corp
Air compressors, service and instrument, 5 ..... Ingersoll-Rand Co
Fire-protection systems ..... American-La France-Foamite Corp
Elevator ..... Atlas Elevator Co
Miscellaneous hoists ..... Bellamy-Robie Co

ELECTRICAL EQUIPMENT:

Storage battery ..... Electric Storage Battery Co
Oil circuit breakers ..... Pacific Electric Manufacturing Co
Spare mg exciter set ..... General Electric Co
Battery-charging mg set ..... Electric Products Co
Switchgear ..... Westinghouse Electric Corp; General Electric Co; Electric Power Equipment Co
Transformers ..... General Electric Co; Westinghouse Electric Corp

BUILDING SERVICE:

Air washers, 7 ..... Buffalo Forge Co
Axial-flow propeller fans, 20; Centrifugal exhaust fans, 3 ..... American Blower Corp
Roof-type exhaust fans, 3 ..... The Trane Co
Foam fire protection equipment ..... Pyrene Manufacturing Co
Fire pumps, 2 ..... Peerless Pump Div

Engineers and constructors ..... Stone & Webster Engineering Corp

AEC Announces Four New-Type Reactors

Experimental reactors will test materials, explore possibilities of ship propulsion, try out high-energy neutrons for "breeding" and power, do same for immediate-energy neutrons

Dr Robert F Bacher, well-known physicist and member of the Atomic Energy Commission, reveals plans for reactors

► WITH A FRANKNESS unprecedented in recent announcements from the Atomic Energy Commission, Dr. Robert F Bacher, well-known physicist, and member of the AEC, has unveiled a new reactor program of first-rate importance. The following account is condensed and reworded from the paper recently delivered by Dr Bacher before the American Academy of Arts and Sciences:

The AEC program includes the planning of reactors for actual construction—also studies that may reach the construction stage at some future time.

Four new-type reactors with specific objectives will form the backbone of the present U. S. reactor-development program:

1: MATERIALS-TESTING REACTOR to study the effects of intense neutron bombardment on materials considered for reactor construction.

2: NAVY REACTOR designed as a land-based prototype of a reactor for use in propelling vessels of appropriate types.

3: HIGH-ENERGY-NEUTRON REACTOR to explore the possibilities of breeding more fissionable material than is consumed in the operation of the reactor—also to explore power production with high-energy neutrons.

4: INTERMEDIATE-ENERGY-NEUTRON REACTOR (Same as 3, but using neutrons of intermediate energy.)

Materials-Testing Reactor. This will do a job basic to all other reactor development. Neutrons of high intensity (high velocity) will bombard test samples, placed in pockets to determine which materials can stand up in the structure, in cooling system and radiation shields. Oak Ridge National Laboratory has been designing this unit and is now planning its construction in cooperation with the Argonne National Laboratory (Chicago).

Incidentally, the materials-testing reactor will release much energy per cubic foot, thus creating a difficult cooling problem whose solution will directly serve other parts of the reactor program.

Navy Reactor. This is now being developed by Argonne. Westinghouse will take over to carry the design through to construction and operation of a land-based prototype of a power source for a naval vessel. The fuel element of both the Navy and the Materials Testing units will be natural uranium (containing 0.7% U235 and 99.3% U238) enriched with U235. Presumably the original charge of uranium would carry a ship tens of thousands of miles, after which the spent-fuel elements would be removed for reprocessing and replaced by a fresh charge. Construction may start early in 1950.

Breeder Fast Reactor. This has been under design at Argonne for over two years. It will operate with neutrons of high-energy level to test out their possibilities of breeding and power. This unit will differ from the present fast-neutron reactor at Los Alamos in its much higher power level and in the use of U235 instead of plutonium as the fuel element in the charge.

Much experimentation suggests that liquid metal should be used to transfer the heat from the nuclear reactor at high temperature. Some metals absorb neutrons only slightly, and the high temperature is needed for efficient power generation.

Intermediate Reactor. General Electric is now designing, for the Knolls Lab near Schenectady, a reactor that will operate with energies intermediate between the high level and the low level of the old Hanford plant. There has been no experience with reactors in this range. It is hoped that the intermediate-energy neutrons may prove effective as breeders of new fissionable material and as power producers. The AEC also announces a reactor-testing station to be set up in the West.

Among problems for future action are development of a reactor to generate power from natural (unenriched) uranium. It is yet to be determined when if ever, atomic power from land-based plants will be economical except in regions without hydro or cheap conventional fuels, but the present program should clear up many questions.

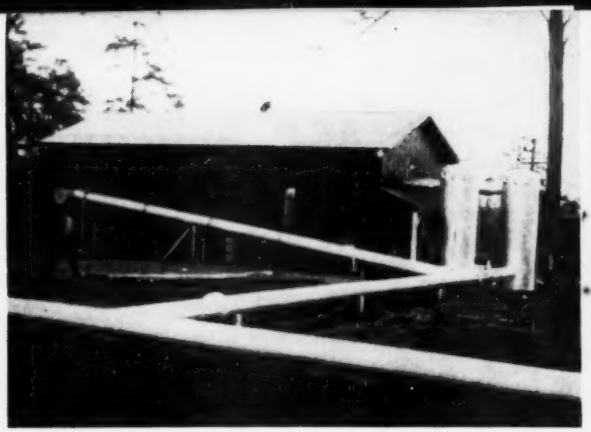
IF YOU HAVEN'T KEPT UP

In any reactor (even an atom bomb) flying neutrons from exploding nuclei of Uranium 235 or plutonium atoms split other similar nuclei. If neutron wastes can be kept within bounds, the process propagates like a letter chain, releasing heat energy equivalent to 1400 tons of coal from every pound of atoms actually split.

The natural uranium used in the older piles (as at Hanford) contained only 0.7% of the fissionable U235 variety and would not maintain a chain reaction if the high-speed neutrons were not first slowed down to "thermal" velocities (like those of air molecules in a room) by bouncing them around among the atoms of graphite, "heavy water," or some other "moderator."

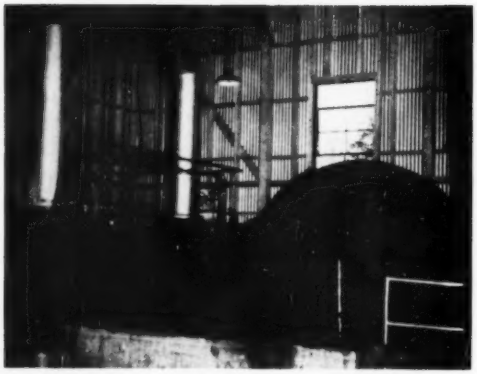
Thus a typical reactor contains natural uranium (often enriched with U235 or plutonium) intermingled with a moderator. The reactor must be equipped with controls to keep the chain reaction from running wild and a heavy concrete shield to protect the operators.

VERTICAL BORE HOLE NO. 4 taps horizontal coal seam 150 ft below, ties into compressed-air line or exhausts to burner

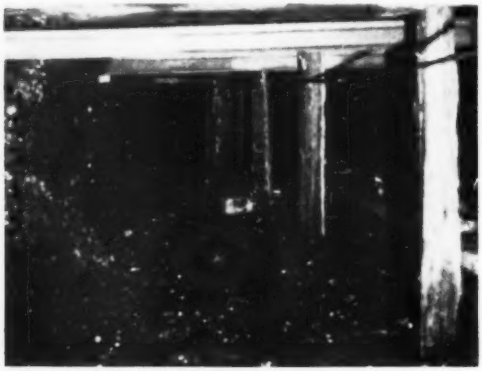


COMPRESSOR HOUSE with two air receivers, right, will supply compressed air for gas runs during experimental trials

Underground Gasification Goes on



RECIPROCATING COMPRESSOR will be primary air supply with capacity of 7200 cfm at 30 psig feeding 20-in. manifold



ONE OF TWO HORIZONTAL shafts driven through 42-in.-high coal seam with steel rails, wooden uprights for roof support

Coal gasification in place promises three possibilities: (1) source of synthetic fuel oil (2) cheap fuel gas for power production (3) economic utilization of thin coal veins too costly to mine by the more conventional methods

By B G A SKROTZKI, *Associate Editor*

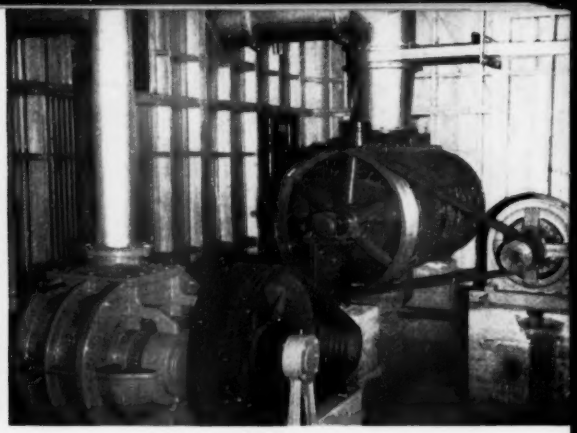
► WE BELLY-WHOPPED into the 1600-ft horizontal shaft of the second experimental investigation of underground coal gasification at Gorgas, Ala. I was one of the party of miners, Bureau of Mines engineers, geologists and editors who, face down and head to feet, rode the coal conveyor to inspect the underground arrangements. Twin shafts had been driven through the 42-in.-high coal bed to provide passage for air and combustion products. These horizontal entries are cross connected as shown in the plan view. Vertical pipes supported on refractory brickwork at these cross connections lead to the surface about 150 ft above.

The twin entries will be sealed off 145 ft from the entrances and pipe connections, made at that level to the air-supply manifold. Though only one horizontal shaft is needed for the setup, mining laws require two for the miners' protection, to provide ventilation and an escape route in case of a serious roof fall in one of the shafts.

Above Ground. Above-ground equipment of this carefully prepared investigation consists of a 20-in. air manifold connecting all the vertical bore holes so valved that air can be forced down any of them. Or the hole can act as an exhaust for combustion products to be used in a burner and perhaps eventually a gas turbine. Air manifold will be supplied by a 7200-cfm air compressor at 30 psig. Two positive-displacement blowers are provided for standby.

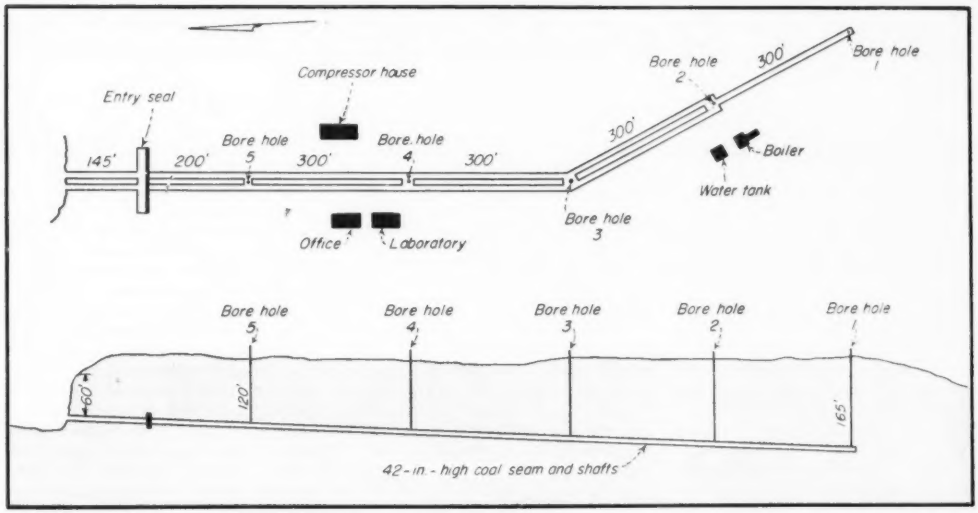
Series of tests will be run to: (1) find the coal quantity that can be gasified from an initial combustion zone and

ASSOCIATE EDITOR Ben Skrotzki riding out of 42-in.-high horizontal shaft on coal conveyor after underground inspection



POSITIVE DISPLACEMENT BLOWERS in compressor house, left one delivers 1500 cfm at 10 psig, other 7000 cfm, 2 psig

Second Trial at Gorgas, Alabama



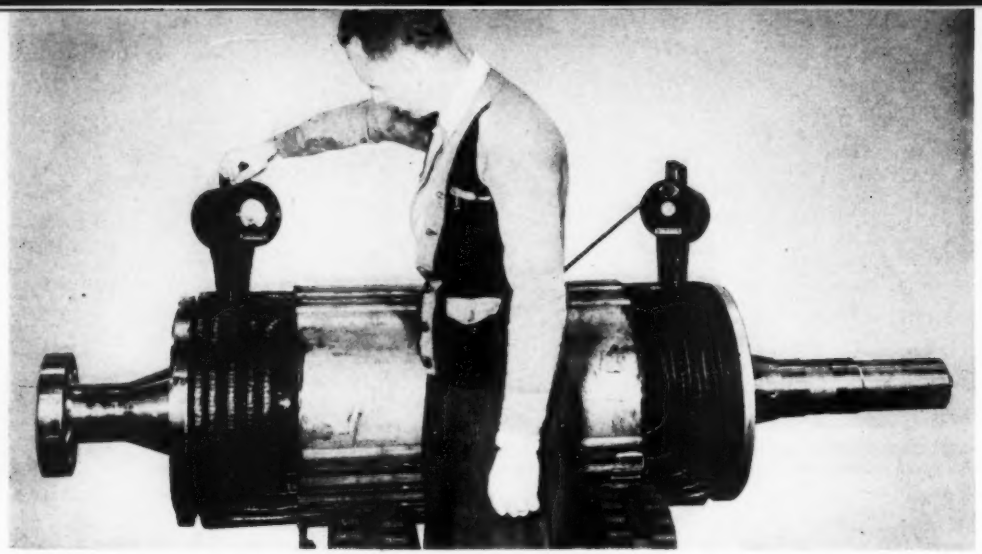
PLAN AND APPROXIMATE PROFILE of horizontal shafts and vertical boreholes driven through coal bed under about 150 ft of overburden. Thermocouple leads and gas-sampling lines terminate in laboratory. Air manifold parallels the shaft

the shape of the burned-out area (2) try out various designs of inlets and outlets at the bore holes and horizontal outcrop entries (3) study operating behavior as gas production proceeds in respect to such factors as passage length, flow rates and pressure drops (4) determine quality and quantity of air-blow product gas generated, as well as tar and related products (5) obtain information on heat action on the overlying strata (6) collect technical and economic data controlling choice of plant sites and installations.

Operating Plan. Initially gas will be produced by the air-blow method, which requires establishing a combustion zone at 3000 F. Hot combustion products then passing over exposed coal faces in the horizontal shaft will react to release volatile matter and produce CO. Remaining coke will be the fuel supply for the fire as it works its way along.

Plans schedule the project to be fired during March 1949 by dropping a thermite bomb down bore hole 1 at the end of the horizontal shaft. Air will be forced down this hole and the gases allowed to escape through bore hole 2, all other outlets being closed. Air flow will be regulated to produce a maximum of CO_2 content and hold down the O_2 to a minimum. Total flow will be increased as much as possible after which it's expected that CO will appear. Operation

(*Continued on page 172*)



1 Short-circuited turn detector in use. Instrument tells if any coil has a shorted turn. Exciter unit to right induces current in shorted turn by transformer action, while meter at left picks up any flow of current in the rotor windings

Locating Shorted Turns in Ac Turbine

Besides explaining the nature of short circuits between the field turns in nonsalient-pole high-speed turbine-generator, the author covers possible effects on generator performance and methods of detection when rotor is opened for inspection

By J F KALBACH, *University of California*
Formerly of Generator Engineering Div, General Electric Co

► TYPICAL CONDUCTOR of an ac turbine-generator field winding is made of rectangular copper with rounded edges. It is insulated with a high-grade built-up mica tape to separate the turns by an insulation thickness of approximately 0.010-in. Insulation on top and bottom turns of each coil is usually doubled. Since the maximum voltage across entire field winding is generally not more than 125-v dc, the working voltage between adjacent turns is rarely greater than 0.5 v.

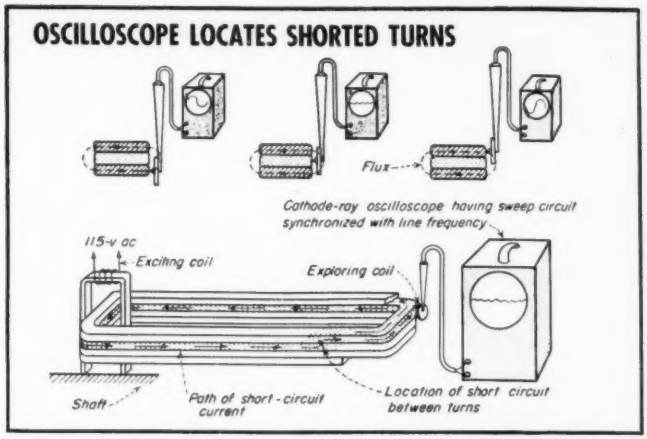
Insulation Thickness. Such low voltage, theoretically, requires considerably less than one thousandth of an inch thickness of mica insulation. There are, however, several reasons why much thicker insulation is used: (1) Continuous thin films of mica without holes or other flaws are difficult to obtain. (2) Thin insulation is susceptible to physical damage during construction, operation or repair of a revolving field. (3) Transient voltages, which are sometimes induced in field windings, can momentarily raise the turn-to-turn voltage.

Typical thickness of ten-thousandths of an inch of built-up mica might withstand far more than 500-v dc between adjacent turns if the effective thickness and dielectric breakdown were not reduced by various flaws. For example, if small ridges or burrs are not removed from copper conductor surfaces or if conducting particles are allowed to fall into the space between turns, pressure of one turn against the other, together with differential expansions and contractions because of temperature changes, is likely to press or rub these burrs or particles into the insulation. This action might either produce an actual short circuit between turns, or merely reduce dielectric breakdown strength.

Effect of Shorted Turns. Under normal steady-state conditions of operation, with the load balanced evenly on all phases of generator, it is doubtful that a few short-circuited turns in the field winding would affect operation noticeably. If generator field current were held at constant value, each shorted turn would reduce the effective number of field turns by a fraction of 1%, and because of saturation in the iron circuits, the generated voltage would probably be reduced even less. Because of the number of total turns in field winding, a large number of individual turns would have to be short circuited before armature voltage would be reduced by 2 or 3%.

If many turns were short circuited, field current would have to be increased to maintain desired generator armature voltage. Heating in active portions of the field winding would be increased in proportion to square of the current, and this might cause the field to overheat when generator is carrying rated load.

If short-circuited turns occurred to



2 If oscilloscope is substituted for amplifier and milliameter, phase angle of ac voltage shifts 180 deg when exploring coil is moved past the shorted turn

3 Electronic amplifier detector, above, uses an exciting unit for operation

Generator Field Coils

allow more excitation on one pole of a 2-pole generator than on the other, there is the additional possibility of an unbalanced magnetic pull although this is less likely than in a machine having 4 or 6 poles. This unbalance might become great enough to produce some objectionable 60-cycle rotor vibration similar to that caused by a static unbalance. Of course, this effect is noticeable only when generator field excitation is on.

Scarcity of instances where short-circuited turns in field windings have apparently been responsible for failures in ac turbine-generators can undoubtedly be attributed to wide acceptance and general use of recommended operating practices, and to care taken in manufacture and repair of revolving fields. Three operating practices that are important in this respect are: (1) observance of nameplate ratings to avoid insulation damage due either to excessive temperatures or to differential expansions caused by excessive temperature differences, (2) use of fault protection to limit and remove quickly any excessive armature currents that may be caused by accidental short-circuiting or improper synchronizing of load, and (3) limitation of unbalanced line currents caused by single-phase loading to values recommended by the manufacturer.

Testing Methods. Without suitable nondestructive tests for detecting short-circuited turns in field windings, it would be difficult to develop techniques for insulating, winding and installing field coils in rotors, and, at the same time, keep them free of short circuits between turns. Several suitable test instruments have been developed for use during the assembly of fields.

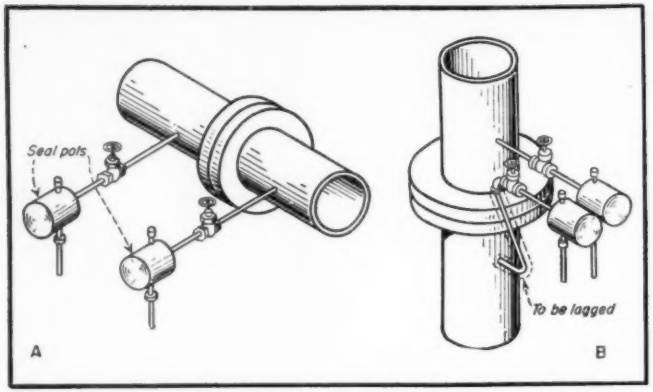
One such instrument, consisting of an exciting and a detecting unit, is shown in Fig. 1. It is capable of detecting short circuits by coil groups; that is, it tells whether any given coil contains a short-circuited turn. Operating principle is illustrated in Fig. 2. Exciter unit consists of a coil wound upon steel laminations bent into U-shape so open legs of U can be dropped astride a field coil at one end of a generator rotor. Legs of unit are long enough to touch rotor shaft below the field coil and thereby complete the magnetic circuit.

When the exciter coil is energized with 60-cycle power, a voltage is induced in field coil turns by transformer action. If a short circuit exists between any two turns of that particular generator-field coil, the induced voltage creates a current flow in a path similar to that in Fig. 2. Presence of any such current is detected by a separate unit placed at opposite end of generator rotor. Indication may be obtained by an exploring coil and a suitable amplifier, or merely by a large coil, which when connected directly to an ac voltmeter gives an indication of short-circuit currents, Fig. 1.

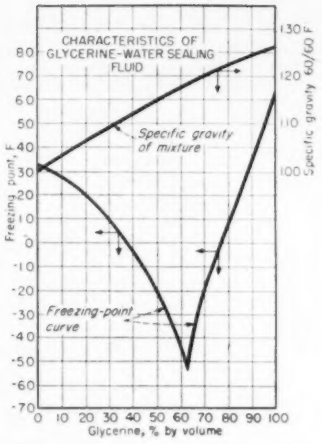
Short-circuited turn detector in Fig. 3 takes advantage of high amplification possible in electronic amplifiers to provide a more sensitive detector. This makes it possible not only to detect the mere presence of a shorted turn, but also to locate often the exact position of a burr or metallic particle causing a short circuit. Operating principle of this short circuit locater is also illustrated in Fig. 2.

Magnitude of current induced in shorted turn by the exciter may vary from one instance to another because of variations in coupling between exciter and shorted turn, resistance at point of short circuit, and depth of the shorted turn in slot. But position of current-carrying shorted turn is determined solely by position of the fault that causes the short circuit.

It is also recommended that after a generator has been put in service, one should use every opportunity to test for short-circuited turns. Such opportunities exist whenever the retaining rings of a generator rotor are removed for inspection, cleaning, or repair of field windings.



1 For steam-metering jobs, piping and seal-pot arrangements *A* and *B*, keep meter near atmospheric temperature with attendant savings in repair and replacement



2 When glycerine content is above 62% freezing point of the mixture rises

The Why and How of Flowmeter

If you have trouble getting accurate flow readings, study these facts about sealing fluids for measuring elements of differential flowmeters. Then check your meter installation

► FOR SUCCESSFUL MEASUREMENT and continued accuracy, you must use the correct seal between a flowing fluid and the measuring element of a differential flowmeter. Sealing is accomplished by injecting a suitable fluid into the space and piping above the mercury's surface in the chambers of a manometer-type instrument or in the body area of a bellows or diaphragm meter. Sealing fluid must fill the connecting piping and part of the pot installed at the primary element (orifice plate, etc.). The seal pot provides a reserve of sealing fluid to accommodate the maximum mercury-level change or bellows movement without an appreciable change in sealing-fluid static head.

Practical Reasons. Measuring steam flow is an excellent example of a condition requiring sealing. Advantages of a water seal are readily apparent, but if steam were allowed to enter it would cause a continually varying water seal depending on how well the lines are lagged. The arrangements in Fig. *1A* and *B* keep the meter near atmospheric temperature with attendant savings in maintenance.

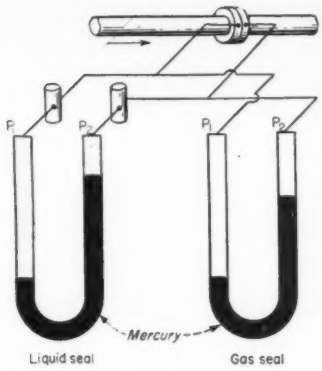
Volatile liquids offer a problem similar to that of steam. Condensed vapor can be allowed to accumulate in the meter chamber and static lines until they are completely filled, but this takes time. It also offers the possibility of stratification, which requires sampling to determine specific gravity for coefficient calculations, and instability from possible variation in condensate characteristics with line or atmospheric changes. It is much more desirable to select a sealing fluid with stable characteristics and use a seal pot or flowing-seal installation.

Fluids Requiring Seals. Vapors that condense at lowest temperature expected on any part of the metering installation must be sealed. Seals are also needed on volatile noncorrosive liquids that may vaporize at process-line temperature or ambient temperature. Effect of atmospheric temperature upon the static lines should not be overlooked. I found it difficult to get consistent readings on an installation measuring feed from a dicyclopentadiene dimerizer. Physical characteristics of the liquid under line conditions seemed to be such that no vapor should appear in the static lines, but pressure changes and increased temperature from the sun caused trouble. Length of static lines and necessity for quick response for control meant I had to use pneumatic transmission with seal pots at the transmitter.

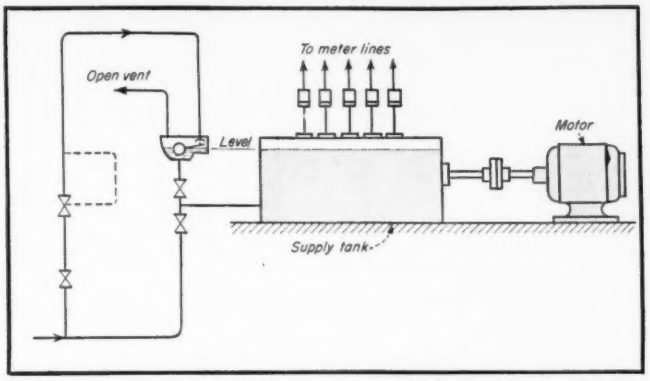
Remote Metering. This experience emphasizes the advisability of giving serious consideration to transmission systems for difficult metering jobs. The same care must be used in engineering the installation of the transmitter as of the recording instrument. Sealing with a noninflammable fluid does not ensure complete protection in making a control room explosionproof. The seal pot does, however, protect the room against line fluid until the sealing fluid is displaced. But unless the operator detects the leak quickly, this does not constitute protection. Transmission systems make it possible to protect control rooms completely.

Seals must also be used for heavy viscous oils and products such as naphthalene or wax, which do not move freely enough to transmit the true pressure from the line restriction (orifice plate) to the measuring element. A seal that does not mix with the fluid being measured is desirable, but often a lighter product of similar chemical nature is used with frequent replacement of that portion of the seal in contact with the flowing fluid. A constant displacement system (flowing seals) will be discussed later on.

Selecting Sealing Fluid. Characteristics of the fluid being metered must be considered in selecting the seal. In general, the sealing fluid should be:



3 Weight of fluid above mercury upsets mercury head and P_1 — P_2 relation



4 Rate of seal fluid flowing to both static lines should be the same. For best results use a flowing-seal-pump drive that can have its speed regulated closely

Seals

By C S BEARD, *Instrument Engineer, Bechtel Corporation*

(1) free flowing (2) nonvolatile under operating conditions (3) noncorrosive (4) preferably heavier than the line fluid and not miscible with it.

Cold climates require water-glycerine or water-ethylene glycol mixtures. Ethylene glycol may be used by itself. Fig. 2 shows the freezing point and specific gravity of a glycerine-water solution. It is not advisable to use more glycerine than needed to protect against freezing as the mixture gets too sluggish. Also freezing point rises when the glycerine content goes above 62%. Using a seal on oil meters has the advantage that the specific gravity of the sealing fluid is constant and does not have to be determined each time the meter is repaired or the seal lines blown out.

Chemical or physical nature of the sealing fluid should be such that inadvertent injection of it into the process line does not cause trouble. An example of this problem occurs in the processing of wax: Beyond a certain point in the process the introduction of practically any dissimilar product, even water, may cause cloudiness in the final product. Also the seal used on any product being refined for human consumption must not be physiologically harmful.

Corrosive liquids or chemicals may be sealed with neutral mineral oil, kerosene or diesel oil. Agitation of a small sample of the proposed sealing fluid in the flowing chemical determines whether carbonization or saponification prohibits the selection. Hallowax oil has been used to seal heavy acids and salt solutions and dibutyl-phthalate (Aquaseal) for weak acids.

Dibutyl-phthalate, which is nonmiscible with water, having a freezing point of -30 F, boiling point of 600 F and specific gravity of 1.05, has been used successfully on steam meters where the condensate, normally used for sealing, might freeze.

Correction Factor. Quite a large error can be introduced into a mercury manometer reading by partial condensation of vapors in the meter piping. Fig. 3 shows that, with a fluid of appreciable weight above the mercury, the difference $P_1 - P_2$ is not the weight of the head of mercury displaced, as it should be, but the head of mercury minus the weight of an equivalent head of the liquid on top of the mercury. Thus a correction is necessary. Solution of the equation showing the values that make up P_1 and P_2 (or $P_1 - P_2$), which is the true differential across the orifice in inches of water, gives the factor $1 - (G_s \div 13.58)$. This applies to any differential reading of a dry calibrated meter; so it may be incorporated in the coefficient for the flowmeter. The differential always appears as the one-half power in the flow equation so the square root of the factor should be used in calculating the flow coefficient.

If the factor is put in the form $(G_m - G_s) \div G_m$, it may be seen that when G_s, or density of the fluid above the mercury G_m, is low the correction is negligible. This holds true with most gas measurements, but very high-pressure gas and some heavy refinery gases, even under relatively low pressures, warrant consideration of this correction.

Flowing Seals. A flowing seal consists of introducing the sealing fluid at a point close to the manometer under sufficient pressure to make it flow back through the static lines and into the meter run at the static taps. Pressure must be enough to cause flow under all line-pressure conditions. Flow rate through both static lines should be the same. Also it should be small. Too rapid flow gives incorrect readings because it affects the static pressure; unequal flows in the two static lines also distort the readings. Speed of the flowing-seal pumps (lubricator or chemical feeder), Fig. 4, may be regulated within very close limits.

Another method is to use an existing pressure line to distribute a usable sealing fluid around the plant, or a special line from a pump or pressure source may be installed. In this case, the flow to each static line must be accurately measured or controlled. Area meters of small capacity may be used with a needle valve for control. Assuming the flow characteristics of both static lines are similar, a differential regulator may be used to supply fluid through identical restricting orifices at just enough increase in pressure above the existing line pressure to cause flow.

Flowing gas seals are used with success where the gas to be measured is corrosive. The area meter can be used instead of the commoner restricting orifice, as the rate can be set more

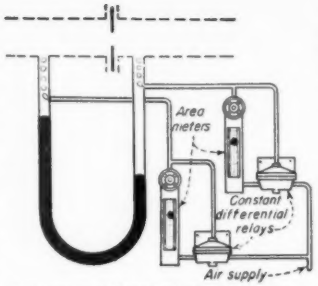
accurately. Fig. 5 shows a differential regulator controlling sealing-gas flow.

Injection Point. Although there is no ironclad rule, the practice of injecting the flowing seal at the manometer rather than at the orifice flange has advantages. Liquid flow from the manometer back to the pipeline tends to work vapor out of the static lines. (Venting vapors into the open is sometimes messy; in most plants, it is also dangerous.) And after loss of seal at an unexpected loss of line pressure, it is not so difficult to get back on the line. Upon loss of flowing-seal pressure by pump failure or other causes, the line fluid will often start to move into the static lines.

When sealing fluid is injected at the flanges, however, resumption of pressure clears the static line between the injection point and pipeline, but leaves the line fluid between the injection point and manometer. Injection at the manometer clears the lines.

Piping Considerations. Seal pots must have enough volume so a change in sealing-fluid level will be negligible with maximum displacement of mercury in the manometer. In Fig. 6 two equalizer lines as well as a valve at midpoint are provided to check for sealing-fluid level. A special valve, available for the equalizer lines, is equipped with vents on each side making it possible to check each pot without opening the bypass.

Accumulation of vapor or liquid is one of the commonest causes of error. Sloping a gas meter's lines (about 1 in. per ft) down to the orifice allows condensate to drain back to the pipe. For steam or liquid, sloping the lines



5 Here a differential regulator controls sealing gas flow to the static lines

toward the meter allows vapor to find its way back to the main. Correct installation and constant use of vents and vent chambers at high points take care of vapor; adequate sediment chambers at low points handle condensate or sludge accumulation.

Orifice taps made on the side of liquid mains minimize the possibility of vapor or sludge entering the static lines. Inserting the taps in the top of a gas line ensures the driest gas entering the static lines.

High points of both static lines should be on the same level so liquid-seal heads are equal. Seal-pot installations and the attendant piping become quite heavy and must be properly supported. The weight may not cause complete rupture but it adds to the difficulty of keeping pipe joints tight.

Placing in Operation. To place a liquid-seal-pot installation in service, purge the entire system of gas or vapor. This is a tedious job if sealing fluid is poured in at the high point, as the gas must work itself out or be worked out by some movement of the liquid or by jarring the pipes. The gas readily escapes if the sealing liquid is forced in from a low point.

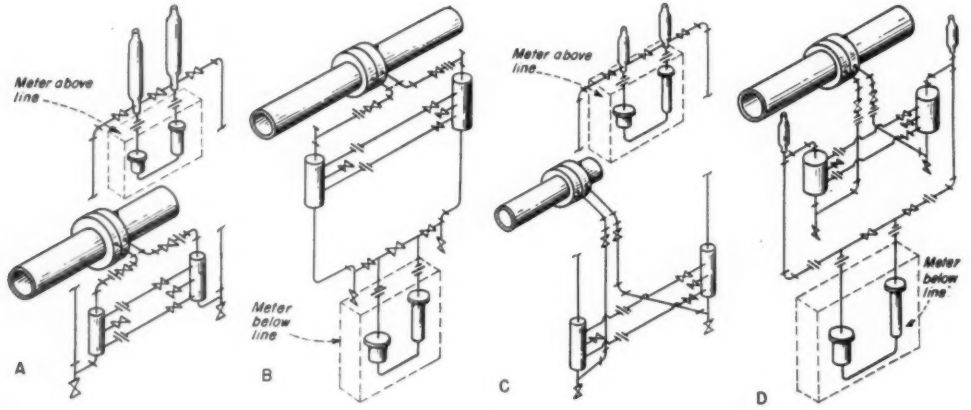
Seal pots should be filled to the halfway point. This is readily determined if the pots have a test cock as in Fig. 6. In the absence of such a cock, correct level can be secured by entirely filling one pot with the sealing fluid and the other with the line fluid. Upon opening the bypasses level corrects itself.

Procedures for filling, venting, zeroing the meter, testing for entrapped air or gas, and other operations vary somewhat with each installation. Consider the following points:

1. Always close the line valves before opening equalizing lines between the pots. Failure to do so causes the sealing fluid to flow into the main because of the differential pressure across the orifice plate or other restriction.

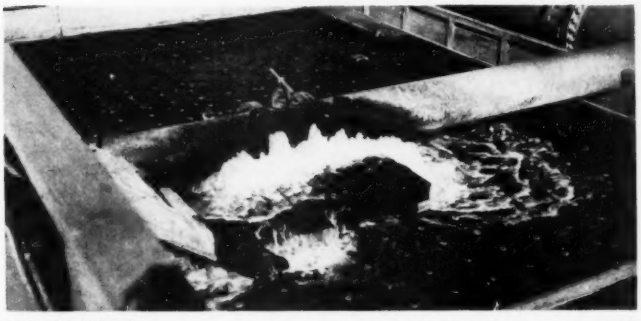
2. Be sure both equalizing lines are open when zeroing the meter, as just one line will not allow the sealing-fluid levels to equalize in the pots.

3. Test for vapor frequently. Do this by (a) closing all valves (b) opening bypass at meter (c) relieving pressure on metering system (d) closing all valves again (e) opening high-side line valve and meter valve. Movement of the pen denotes vapor in the high-side meter chamber. Additional movement of the pen upon opening the low-side meter valve indicates vapor between this valve and the downstream line valve. The upstream static line may be tested similarly by opening the downstream line valve and meter valve.

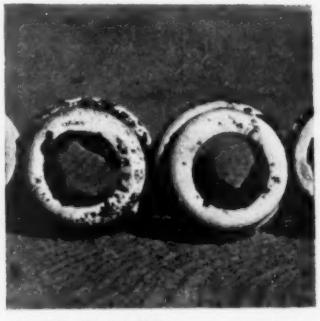


6 Equalizer lines as well as a valve at mid-height of seal pots make it easy to check sealing-fluid level. Line liquid lighter than seal liquid, *A* and *B*; line liquid heavier than seal, *C* and *D*. In *A* and *C*, meter above line; *B* and *D*, below

CONDENSER SUCTIONS at the Riverview plant in Borger, Texas, have been chlorinated periodically for the last three years. In that time, the condensers have needed no cleaning although spray ponds and cooling towers are ideal for algae growth



COOLING-TOWER deposits of algae that grow attached (chlorophyceae), particularly so in water that is exposed to direct sunlight, are the most difficult to control



PARTIAL PLUGGING of tower nozzles by algae causes an uneven water spray

Plant Needs Determine Chlorination Practice

Condensers must be kept clean to hold a good vacuum. If you decide to do the job with chlorine select one of the feeding methods described here that best fits your plant requirements

By S L TERRY, *Results Engineer, Southwestern Public Service Co*

► CHLORINATION of circulating water in steam-electric power plants for the control of algal and bacterial growths has several advantages that should not be overlooked when selecting an algaecide. Proper application of correct amounts of chlorine keeps the system clean and eliminates costly shutdowns for cleaning and equally costly periods of operation at low efficiencies and decreased output.

Chlorine Effects. Except in a few plants using tannin or other chlorine-consuming organics, corrosion rate and scale-forming characteristics of cooling water are not appreciably affected by chlorine, and the pH of the average system is well within the range of satisfactory chlorination. This greatly simplifies the problem of algae and bacteria control because the amount of chlorine fed can be varied, or started and stopped, with no adjustments or changes in other water-treating schedules.

In short, chlorination may be considered an independent project and, except for the mechanical manipulation of the machine used to feed the gas to the system, the only attention needed is a simple colorimetric test to indicate the amount of unconsumed chlorine present in the water.

Study the System. Most logical approach to a chlorination problem is to consider the general theories involved, and study the system characteristics that might influence effectiveness of the chlorine. It is well known that chlorine will react with many organic materials, both living and dead, that most surface waters contain. The amount present affects the chlorine demand of

the water, and this demand must be satisfied before a residual can be established. Unless a residual of at least 0.2 to 0.3 parts per million is maintained the living organisms may develop an immunity to chlorine and cause troublesome deposits composed of certain slime-forming bacteria and several types of algae.

In systems completely closed to sunlight, deposits formed in the condensers are usually light, since algae grow most vigorously in the sun. Some types require direct sunlight, while others grow very well in the absence of sunlight but in water that has been recently exposed to the sun.

Major Offenders. Observation of the various forms of organisms found in cooling systems has shown that the slime-forming bacteria and algae known as cyanophyceae are the easiest to kill with chlorine. These are the major offenders in condenser deposits. The chlorophyceae are algae that grow attached and are the most difficult to control, particularly so in water exposed to direct sunlight. It is this type that causes troublesome cooling-tower deposits.

In surveying a system to determine the most practical method of chlorination there are several factors to consider. First, what results are expected? The condensers should be kept free from bio-fouling, and cooling towers must be kept fairly free of algae; at least sufficiently clean not to hinder their performance. Equipment-cleaning costs should be carefully checked.

Usually it is more economical to chlorinate condensers than clean them mechanically, but some systems may require 10 lb of chlorine daily to keep the condenser clean, while 40 lb daily is needed to keep the cooling towers clean. Here it may prove more economical to use the minimum amount of chlorine necessary to obtain good condenser performance and clean the cooling tower mechanically. Trial runs and cost records are needed to show what part of the system is to be kept clean with chlorine and what part cleaned mechanically.

Method to Use. Another factor to consider in selecting a chlorination program is the equipment and personnel available to do the job and whether the chlorine is to be fed intermittently or continuously. Latter method consists of adding chlorine to the system continuously and varying the feed to maintain a total residual between 0.2 and 0.3 ppm. Intermittent feeding introduces about 2 ppm of chlorine to the condenser suction for 30 min to an hour each day. In the first case residual is maintained so that bio-fouling is prohibited; in the second such growths that develop each day are killed and removed during the short chlorination period. Both methods produce equally good results if controlled properly.

Normal Losses. If a residual is to be maintained, sufficient chlorine must be added to establish it and for a recirculating system, to replace the chlorine aerated out. This aeration loss varies upward from a minimum of 20%. Smallest loss is from cool water passing over a tower and highest loss is usually experienced when passing warm water (90 to 95 F) through sprays on a windy day when a lot is carried away.

Feeding Rate. Once the original chlorine demand of the system is satisfied, feeding rate depends on (1) chlorine-consuming matter in the makeup water (2) organic matter blown into the pond or cooling towers (3) aeration loss through the cooling section of the system, and to some small extent by blowdown. Amount required to satisfy the chlorine demand of makeup water can be calculated from an analysis, and if the source is reasonably constant the figure can be used to estimate the chlorine feed. But very often makeup is from a surface supply and the chlorine demand constantly fluctuates. Since aeration loss also varies, it is readily apparent that estimates of chlorine consumption should be given considerable leeway, and that control testing is necessary for good results and reasonable economy.

If chlorination is done intermittently the problems become fewer. The theory of chlorinating for a short period each day is that enough of the gas can be fed to the system to kill and remove all bacterial and algal growth in the surface condenser and to kill the growth on cooling towers. It is quite possible to maintain clean condenser tubes and practically clean towers in a system without completely satisfying the chlorine demand of the whole circulating-water system. In a once-through system intermittent chlorination is usually adopted to remove slime from the condensers. In systems having large water areas exposed to the sun or so constructed as to collect considerable organic trash and debris, periodic treatment may often be considerably more economical and still give as favorable results as the continuous method.

Winter Treatment. There are many plants where bio-fouling gives very little concern during the winter months. If condenser performance is regularly checked by observing the logarithmic mean temperature difference (LMTD), heat head, or some such figure, it may be found that "slugging" each day is unnecessary. One or two treatments per week often maintain efficient rates of heat transfer. If continuous chlorination is practiced, the same residual is maintained constantly both winter and summer, but less chlorine is needed in winter.

The scientific approach to any problem usually starts with a general review of the theory involved. The best solution offered, however, must be supported by operational data that prove results have been obtained. Practically all plants can maintain clean condensers, but because of system characteristics and operational procedures, most plants will have to try both methods of chlorination to find the one that most economically produces the results desired.

COMPARISON OF INTERMITTENT OR "SLUG" TREATMENT WITH CONTINUOUS FEEDING FOR THE SAME SYSTEM

	Periodic	*Continuous*
Results	1. Good if fed at the rate of 2 ppm for ½ to 1 hr per day	1. Good if properly controlled and total residual is kept near 0.3 ppm
Chlorine consumption	2. May be directly calculated when pump capacity is known. Usually less than continuous	2. Must be determined experimentally since estimates may be off more than 30%
Equipment needed other than chlorinator	3. None	3. Simple color comparator and one solution
Control tests	4. After schedule has been found satisfactory, no tests are needed	4. Tests for proper total residual is necessary. Tests may be made hourly to daily depending on the type chlorinator used
Chlorination machines	5. May be very simple but must be large-capacity devices to deliver the high rate needed. If a homemade device is used, extreme care must be used that it is safe	5. Equipment must operate continuously at varying rates, hence the more elaborate automatic proportioners are more practical for some plants

FLEXIBLE COUPLINGS

By J J O'CONNOR, *Assistant Editor*

Simple in appearance and unobtrusive in operation, flexible couplings do not call attention to themselves. Thus, these connections between driving and driven machines are all too often treated lightly although designers and operators direct valuable time and effort toward planning and selecting the machines themselves. Yet failure to select the right coupling for the job, and to install it properly, can undo the efforts of both machine and coupling designers.

Full realization of the part a coupling plays in connecting two machines and careful selection based on such realization avoid many operating troubles and potential shaft or bearing failures.

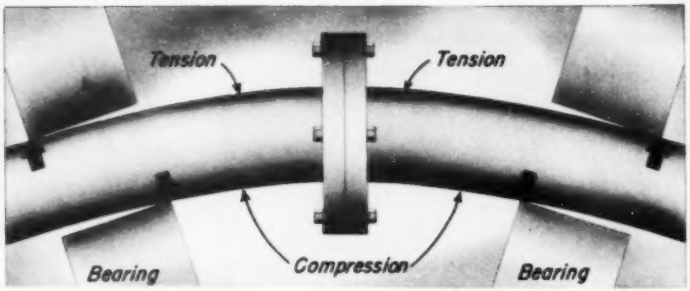
Successful coupling application begins with a clear understanding of two fundamentals: (1) The coupling transmits *all* power between driving and driven units. Hence it must be capable of handling all peak loads, shocks and sustained overloads encountered in daily operation. (2) A coupling is not wisely used when it is called on to connect two shafts originally out of line. Its job is to protect against the misalignment that inevitably occurs under operating conditions.

To emphasize these points, and others basic to applying and using couplings successfully, this special section, POWER's 71st, starts with a discussion of the "why" of flexible couplings, and the factors involved in selection.

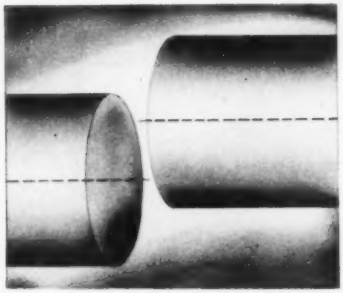
Since many engineers are unfamiliar with the great variety of coupling designs that are available, we are devoting much space to illustrating and explaining the features of the various units. We have made no attempt to catalog flexible couplings into application classifications. This would be impracticable since most types overlap in their applications. Rather, the many designs are grouped according to basic operating principles.

In this strictly practical treatment the effort throughout is to give you, the power engineer, the information you need to select, install and operate flexible couplings successfully — an understanding of the job a coupling must handle, the types of couplings available, and the steps involved in determining coupling size. Use this special section to make your machinery run more smoothly — it will pay dividends in trouble-free operation and lower production cost.

SHAFT FATIGUE AND BEARING WEAR STEM FROM RIGIDLY CONNECTING



1 Alternate tension and compression stresses are set up as rigidly coupled, misaligned shaft rotates. Exaggerated case shows points of heavy bearing load



2 *Radial or parallel misalignment* can usually be spotted with straightedge

WHY FLEXIBLE COUPLINGS?

When a machine and its driving unit are in line, their shafts are usually connected by a *coupling*. If both shafts could be maintained in perfect alignment, solid or rigid flange couplings would be suitable. But perfect alignment is not only difficult to obtain, it is also practically impossible to maintain. Hence the need for *flexible couplings*.

Possible Damage. Why not just get along with the out-of-line condition? Well, misalignment of machines connected by rigid couplings not only causes excessive wear of bearings and machine parts, but increases power consumed. When two out-of-line shafts are connected rigidly, severe bending stresses are set up in each shaft. For each revolution, the shafts pass through a complete cycle of tension and compression stresses, Fig. 1. If this condition were maintained, continued reversal of stresses would be likely to fatigue the shaft metal.

Another important consideration is the possible overheating and excessive wear of bearings. Then, too, for an electric drive, rigid coupling prevents the rotor or armature of the motor from drifting to its true magnetic center. It is possible under the latter condition to cause heavy end thrust. Hence, it was but natural that the flexible coupling was developed to handle conditions beyond the limitations of its rigid counterpart.

General Classifications. Fundamentally, there are but two ways of obtaining flexibility in a coupling: first, through use of a yielding element, such as rubber; second, through mechanical design, providing for movement between rigid coupling parts, Fig. 6 and 7. While many flexible couplings are manufactured that fall strictly in one or the other of these elementary classifications, others are available that combine both principles. Further on in this special section we will cover in detail the popular types of flexible couplings that fall within these classifications. Note that the yielding element may be rubber, leather, a liquid-filled gland or flexible metal disks. Those couplings that use mechanical design alone for flexibility may have a floating center, gear or chain as the working member.

At this point we want to stress that a flexible coupling should not be considered as a cure-all for poor workmanship when machines are installed, but rather as a corrective for *unavoidable* misalignment. Machines connected by flexible couplings should be aligned as carefully as if rigid couplings were used. The purpose of a flexible coupling is not to act as a universal joint, or even to compensate for gross errors of alignment, as is frequently assumed. Even though many flexible couplings can be operated under considerable misalignment, they should not be because such operation subjects them to unnecessary wear.

Hence, not only should the machines concerned be carefully aligned on installation, but this alignment should be checked at regular intervals and corrected if necessary.

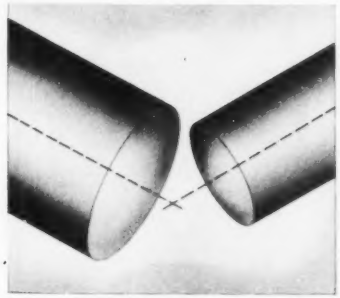
A good way to look at flexible couplings is to consider them as misalignment insurance—a provision to take care of errors in alignment that may develop after the machine has gone into service.

If we put into service a machine that is out of line by 50% of the amount the flexible coupling can compensate for, then 50% of the investment in misalignment insurance has been lost.

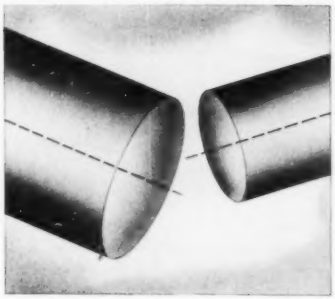
Scope of Flexibility. Couplings can have flexibility in four directions; tangential, angular, radial and axial. Some couplings have all four, others are limited to two or three. Many applications require all four, while others do not.

Let us analyze these four fundamental points of flexibility. Starting with tangential, we may define it as that quality which permits a torsional resiliency between the two solid halves of the coupling. When there is a sudden change of load the coupling allows a certain amount of rotational displacement between its two halves. We can better visualize this if we consider a coupling with a

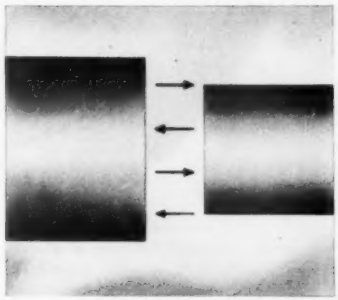
SHAFTING WITHOUT PROVIDING FOR MISALIGNMENT AND END FLOAT



3 Many flexible couplings are designed to handle only *angular* misalignment



4 Combination parallel and angular is probably the commonest misalignment



5 Ample end float lets motor's rotor stay in its proper magnetic center

piece of rubber inserted between the two fixed members. In many applications, this type of drive is desirable, in others it is immaterial, while in still others it may be objectionable. On the other hand, tangential flexibility allows the coupling to act as a shock absorber between the prime mover and the load. This same feature will come into play if it is desired to prevent vibration being transmitted between the two coupled shafts.

Radial flexibility allows shaft centers to be outside the same straight line; coupling faces may be parallel but shaft centers will not coincide, Fig. 2. Flexible couplings should have this feature along with angular flexibility.

Angular flexibility, Fig. 3, compensates for the axis of the two shafts not being parallel. Under this condition the faces of the two coupling halves are not parallel. All types of flexible couplings possess this characteristic, some to a greater extent than others.

Axial flexibility permits float between the two coupled shafts. Degree of axial flexibility in a coupling is often affected by the load transmitted; at light loads some couplings allow free axial movement between the two shafts, while at heavy loads friction of the coupling parts practically prevents this action. In short, axial flexibility allows one member of the coupled units to slide, if necessary, parallel to the axis of rotation.

Selection. It is worthwhile to review some of the fundamental points to consider in selecting a flexible coupling. Ordinarily this type is used to connect two shafts. Regardless of any other factor, the coupling eventually chosen should be big enough to go on the larger of these two shafts. Surprisingly enough, it is not uncommon for a manufacturer to get a request for a coupling to fit a shaft that is bigger than the coupling itself.

Another basic nugget of information is to check whether the coupling being considered will carry the load involved. We're not going to go into calculating coupling size at this point. You will find that information on the last page of this special section. Also, take into consideration the surrounding conditions in which the coupling will operate. Consider temperature, dust, dampness, etc.

Coupling size should be carefully determined so it operates satisfactorily and handles the peak load that is to be carried. It is a common error to pick a coupling too small for this peak load. All coupling manufacturers have simple sizing charts to aid in selecting their various couplings.

Much careful design effort is wasted when a driven machine is connected to a prime mover without careful consideration of the type of flexible coupling to be used. The coupling is often considered a minor element because some form of it must be used in every direct hookup. As a result, the work and effort of both the machine designer and the coupling manufacturer are wasted when a poor selection is made.

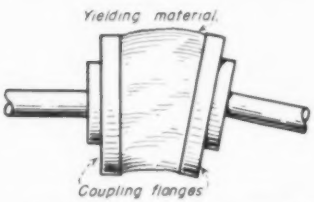
Remember that a flexible coupling is not designed to change the direction of the original shafting. It should be installed, as nearly as possible, when the shafting is in perfect alignment. As time goes on and shaft misalignment occurs because of shifting equipment, shaft flexing, loose mountings, vibration or other causes, the coupling can compensate for the misalignment before corrective maintenance can be effected.

THE TWO BASIC PRINCIPLES IN COUPLING DESIGN

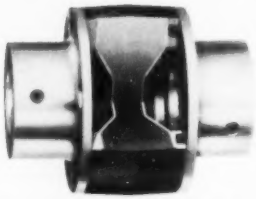
6 Yielding member between the coupling flanges will absorb all misalignment

7 Misalignment is handled by sliding rigid members; no yielding material

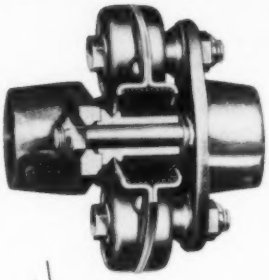
THESE COUPLINGS HAVE A YIELDING ELEMENT THAT IS INSERTED BETWEEN

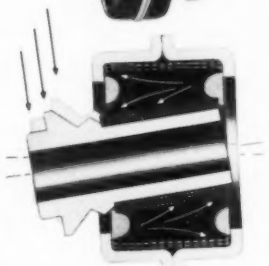


1 Fundamental coupling construction using a yielding element to absorb shaft misalignment. Rubber, leather or steel disks may be the flexing member

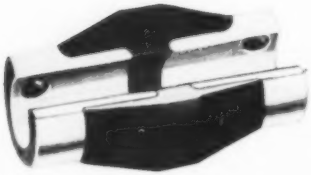


3 Rated 2 to 15 hp at 1750 rpm, this coupling may be installed after the equipment is bolted in place. Neoprene inserts may be replaced if necessary

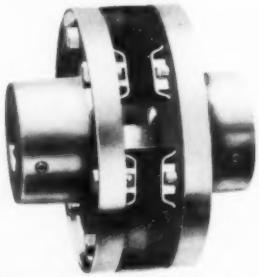




5 Lower cut shows displacement of the rubber biscuit under angular misalignment. Four such biscuits are used between driving and driven flanges. For extreme misalignment, two couplings are connected through a center plate



2 Vibration and regular misalignment are absorbed by soft neoprene center. Yielding member bonded to steel hubs. Designed for 1/50 to 1 hp at 1750 rpm



4 Flexing element is series of small neoprene spools bolted to coupling flanges. When operating at rated torque twist angle between flanges is 3 deg

USING YIELDING PARTS

When two rigid halves of a coupling are connected by a yielding element, its elastic properties, Fig. 1, take care of all misalignment.

Probably the simplest example of this type is the coupling in Fig. 2. It is actually a special-purpose coupling with high torsional deflection. The high deflecting ability stems from use of synthetic rubber (neoprene) bonded to the steel coupling flanges. Entire assembly transmits loads by stressing the rubber in shear. Within certain limits, shear-stressing rubber gives a linear deflection. This particular coupling is suitable for transmitting 1/50- to 1-hp at 1750 rpm. Same yielding element is used for coupling, Fig. 3.

Action of the bonded flexing member is easily understood by realizing that the coupling actually winds up under load, twisting the rubber. Coupling, Fig. 3, is suitable for loads between 2- and 15-hp. It has no bearing surfaces to wear, needs no lubrication, and may be installed after equipment is bolted in place.

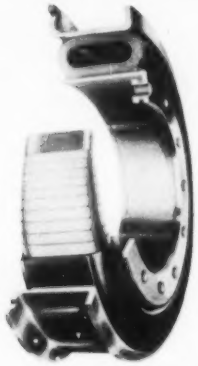
This same fundamental type of construction is incorporated in the unit shown in Fig. 4. Coupling is rated 20- to 100-hp at 1750 rpm. Yielding member takes the form of a spool having a neoprene center. Coupling will deflect through a twist angle of 3 deg when carrying rated load, and is designed to handle a maximum misalignment of 1/32-in. parallel and 2-deg angular.

Biscuit Construction. Rubber-biscuit assembly forms the nucleus of flexible element in coupling, Fig. 5. Cutaway view of biscuit illustrates how rubber is displaced under angular deflection. It is easy to see how this rubber biscuit takes up thrust or axial load since natural flow of rubber permits end float, preventing undue thrust loads on driving shaft bearings. Heart of the flexible element, the biscuit core, is surrounded with a fabric ring impregnated with molded rubber, permitting a press fit to the central bushing.

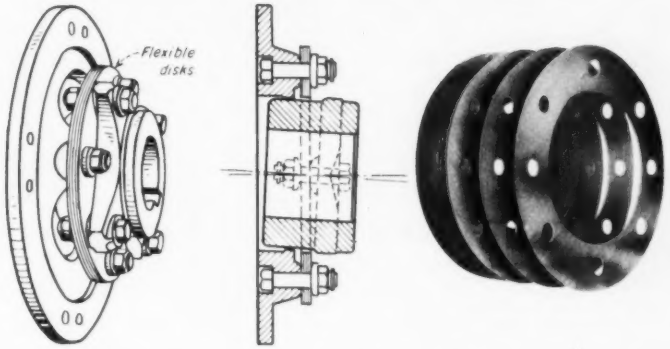
For extreme misalignment, this coupling is available with a double set of flexible elements. It may be considered as two couplings in series with a minimum of space between. This space consists of a center-plate adapter held by through-bolts.

The same biscuit principle is used in similar couplings designed for heavy torque loads, shocks, or high-frequency load reversal. In this construction the biscuits are placed radial to the hub. Once again there is an absence of metal-to-metal con-

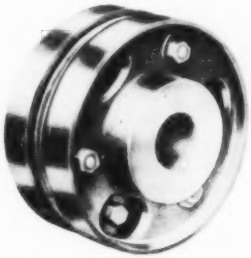
RIGID FLANGES TO TAKE CARE OF MISALIGNMENT AND END THRUST



6 Glycerin-filled rubber gland, bonded to inner and outer flanges, is the yielding member. Outer rim is designed for bolting to flywheel or an adapter



7 Designed for engine-driven single-bearing generator drives, this coupling supports weight of the generator rotor. Safety feature is incorporated to prevent rotor from falling should coupling break. Flexible member is a series of steel disks fastened to flanges with through bolts, eliminating all backlash



8 Thermoid disks are assembled between semi-steel hubs and bolted together with steel driving pins. The impregnated disks are not affected by water, oil, acid or dust. Smooth flange construction simplifies initial lineup of coupling

9 Flexible-disk construction, Fig. 7, is incorporated in the above floating-shaft coupling. Weighing 41,000 lb, 20 ft in length, unit shown has a capacity of 16,000 hp at 200 rpm. Floating-shaft principle provides for extreme misalignment

tact. Since this radial biscuit coupling is stiffer than those in Fig. 5, it compensates for only small misalignment. Nevertheless, it is still considered a torsionally resilient coupling and is often used to isolate engine vibration.

Rubber Gland. Coupling in Fig. 6 has as its flexible element a sealed rubber gland filled with glycerine. Steel driving and driven flanges are bonded to inner and outer diameters of gland. This nonlubricated coupling, designed for high-torque fluctuating loads, is suitable for internal-combustion engines and construction machinery.

Flexible Metal Disks. Power is transmitted through metal disks in coupling, Fig. 7. Normal misalignment is taken care of by slight bending of these disks. Couplings are also available with double rows of disks. They are designed with two to five points of attachment depending upon load and service conditions.

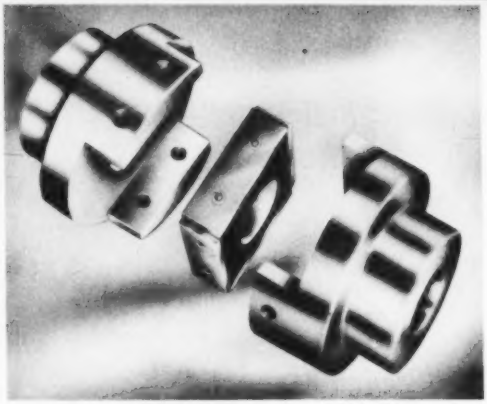
Coupling illustrated in Fig. 7 is suitable where only angular misalignment need be taken care of. Such is the case where an engine with two or more bearings drives a one-bearing generator. Coupling then carries weight of generator rotor.

This coupling eliminates all backlash, an important feature for swinging loads or reversing service.

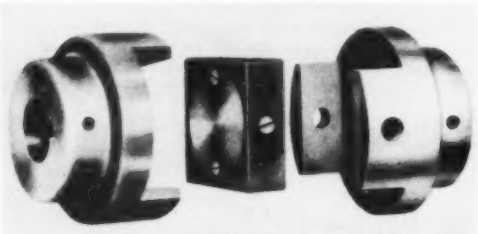
When two single-engagement type couplings are used with a floating shaft between, the assembly takes care of parallel and angular misalignment, Fig. 9. Length of floating shaft is one of the determining factors in the degree of misalignment that can be handled.

Double-type coupling, mentioned above, has two sets of metal disks. They may be used to connect two machines where each is supported on two or more bearings. They are no different in principle from two single couplings with a short shaft between them. Two inner-half couplings may be considered as compressed into a center ring. Once again it is the floating center member that adjusts for parallel misalignment. When operated at rated horsepower and within misalignment limits, the stainless steel disks resist fatigue.

Thermoid Coupling. Coupling in Fig. 8 has a flexible insert made of thermoid disks. This material is not affected by oil, water, dust or acid. Disks are assembled between semi-steel hubs, bolted together with steel pins. Note that flexibility is achieved by bolting diagonally opposite holes on disk to separate halves of coupling.



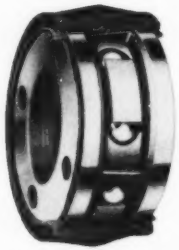
1 Nonflexible, floating center member, sliding between two pairs of restraining parallel jaws, compensates for any misalignment of connected shafts. Four replaceable bearing strips on center member are lubricated from reservoir within



2 Controlled lubrication of center-block faces is handled from a self-contained oil reservoir. Floating block has no bearing strips as in Fig. 1. Oil reservoir can be refilled through hole in flanges without disturbing the coupling

WORKING ELEMENT IS A NONFLEXIBLE FLOATING MEMBER BETWEEN FLANGES

3 Steel centerpiece is machined for sliding fit in the semi-steel end castings; frequently used to connect low-speed shafts carrying high torque



4 Accommodates parallel misalignment to 1/8 in. and angularity up to 3 deg, by steel balls set between end flanges. Over-all seal holds lube in and dirt out

NONFLEXIBLE ELEMENTS

Second fundamental type of flexible coupling depends on mechanical design alone for flexibility. One such unit, Fig. 1, compensates for misalignment of connected shafts through a nonflexible floating center member, which slides between two jaw flanges.

Floating Center. Coupling has only three parts: two jaw flanges and the floating center member. Flanges are each fastened to a shaft; they are not bolted or connected together in any way. In this type of coupling the flange jaws touch only the bearing surfaces of the center member. This device compensates for parallel, angular, and combined parallel and angular misalignment, in addition to providing free end float for axial movement of either shaft.

Also using a floating center member, Fig. 2 incorporates controlled lubrication of its center block. Floating member is oiled from a reservoir within the block. Reservoir can be refilled without disturbing connected machine. In this design flanges are nickel semi-steel while center block is nonmetallic material.

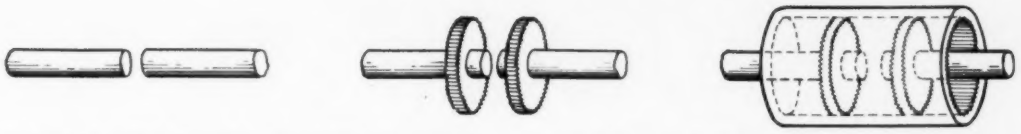
Still another design of the floating center is shown in Fig. 3. Here, the floating center has a different shape and is made entirely of steel. Center disk has grooves and is designed for a sliding fit. Coupling is suitable for transmitting heavy loads and for connecting low-speed shafts where heavy torque is encountered.

Steel Balls. Still another design is shown in Fig. 4. In this type the in-between elements are steel balls. Only flexible element this coupling has is the covering used as an overall seal to retain the lubricant and keep out dust and liquids. Friction is lowered by using hardened steel balls which transmit all force.

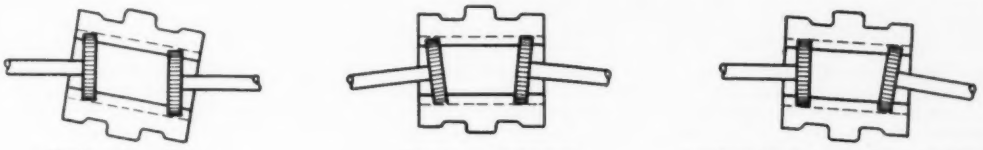
This coupling accommodates parallel misalignment up to one eighth of an inch, and angular misalignment of 3 deg. It is supplied packed with lubricant to last for the unit's life and is sealed from dust or liquids.

Fundamental principle behind the gear or spline-type flexible coupling is illustrated in Fig. 5. Here we see how a splined hub is fitted to each shaft with an internally splined

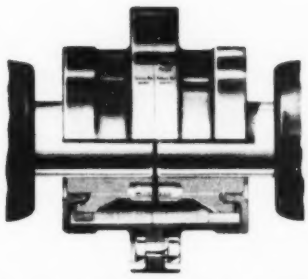
EVOLUTION OF THE SPLINED SLEEVE COUPLING AND HOW IT WORKS



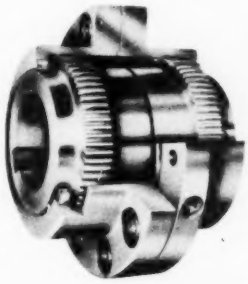
5 Couplings using a floating sleeve follow the fundamental design shown above. First a splined hub is fitted on each shaft end. Sleeve is cut with internal splines to engage the hubs. When one shaft turns, assembly rotates as single unit



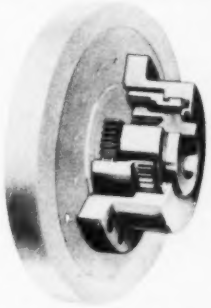
6 Here's how the splined sleeve compensates for the three possible kinds of misalignment. End float is provided for since the hubs can move together or apart without affecting compensation for misalignment. All splines operate in oil



7 By locating load-carrying surfaces at the maximum distance from shaft ends, misalignment between splines is reduced to 1/10 that between the shafts



8 Lubrication at teeth is maintained by centrifugal force while coupling is in motion. Large area of lubricated surface cushions torsional shock loads



9 Suitable for connecting shafting of different diameters where the axial space is limited. The rigid flanged hub, shown at left, mounts on largest shaft

sleeve engaging the hubs. When one shaft turns it rotates the sleeve, which in turn rotates the driven shaft.

Coupling in Fig. 7 is filled with oil. Revolving motion spreads this oil over inner circumference of sleeve and the load-carrying surfaces are then entirely submerged in an oil bath. This positive lubrication creates a permanent film of oil between the splines, lubricating the sliding contacts between their surfaces.

This film, which is always present, distributes the pressure uniformly between each engaging pair of contact surfaces. Pumping action between the load-carrying surfaces provides a fresh supply of oil to gear faces twice every revolution.

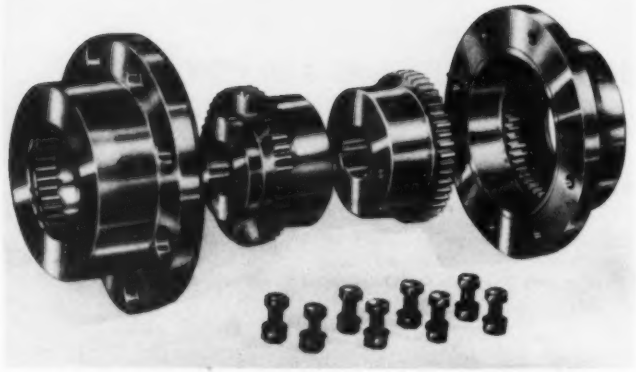
Heavy oil is used in this coupling for heavy-duty reversing load. When direction of rotation is changed, each oil-filled pocket acts as a dashpot, cushioning the gears at the moment of reversal. All moisture, dust, flying grit and other foreign substances are kept out by the metal-to-metal seal at the bearing ring.

A similar design of gear flexible coupling is shown in Fig. 8. Once again the load is carried on the gear teeth, which mesh with corresponding teeth on the interior of floating sleeve member. This particular construction has large pressure surfaces, hence low unit stresses in load transmission.

Gear teeth are the only parts in contact and they are continually submerged in oil because of centrifugal force while running. This action insures ample lubrication and reduction of friction and wear. An oil-filling plug is provided on the coupling flange into which oil should be poured before the unit is started up. Grease or light machine oil should never be used in this type. The coupling is designed to operate equally well in either direction, continuous or reversing, and at high or low speeds.

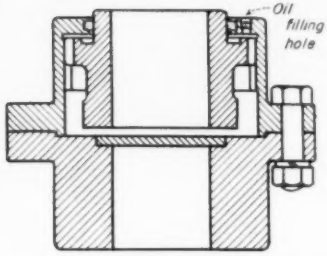
Insulated Sprocket. Coupling shown in Fig. 12 is a simple 2-piece sprocket type. The female end is molded synthetic material, which is not affected by heat or cold, oil, water, gasoline, and many acids. Another feature is lightness of weight.

The synthetic material used in

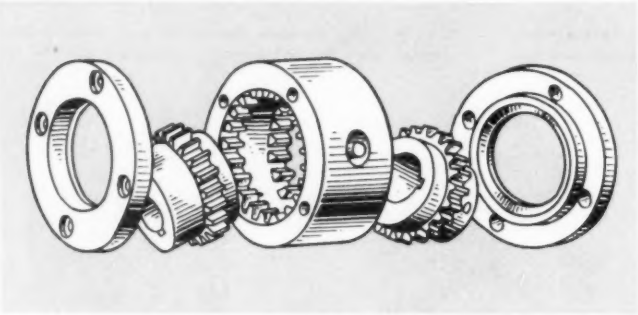


10 When installing, first slip sleeves over respective shafts. Force hubs in place, bringing shaft ends flush with hub ends. Use straightedge across top and sides of hubs to check parallel alignment; make angularity check with a thickness gage between hubs. Bolt flanged sleeves together, then fill with oil

SINGLE-ENGAGEMENT

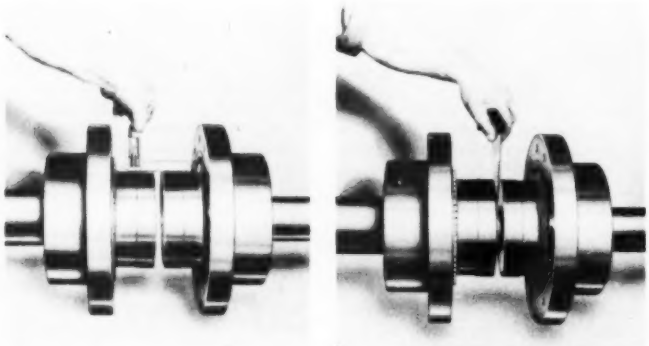


11 Single-engagement type designed for vertical mounting. Coupling handles angular misalignment and end float. Available with double engagement sleeve



14 Two plates located at coupling ends serve to center the floating sleeve with respect to the hubs. Minor misalignment is compensated for by the sleeve assuming a neutral position between both shaft hubs. This coupling uses a thin grease for lubrication, depending on centrifugal force for proper distribution

SIMPLE TESTS FOR PARALLEL AND ANGULAR ALIGNMENT



15 Procedure outlined under Fig. 10 is illustrated above. This particular unit has alignment bands machined around the end of each hub to simplify parallel lineup. Correct gap distance is stamped on hub. Taper gage checks angular alignment and correct hub spacing. Renew the oil and check the alignment periodically

this coupling is a good electrical insulator. Hence, a motor equipped with the female half of the coupling is completely insulated from the unit it drives. This feature is handy where it is necessary to eliminate circulating shaft currents.

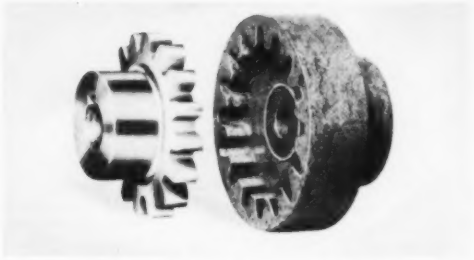
Where space limitations make a close-coupled connection necessary, the coupling in Fig. 9 is particularly suited. In fact, by bolting the coupling flange directly to a flywheel or similar equipment, complete flexibility is provided between driving and driven units in less than one half the space occupied by the usual design. This coupling can also be provided to connect shafts of widely different diameters. When so used, the flexible member is mounted on the smaller shaft and the rigid flange hub on the larger.

A similar design is also used in connecting shafts having an overhung brake drum or similar part. Web of brake drum or other part is machined to mate flanged outer sleeve, which is bolted directly to it. Then, again, this type may be used combined with magnetic or pneumatic clutch coupling. Many clutch couplings require a flexible member, and this unit may be used to provide desired flexibility.

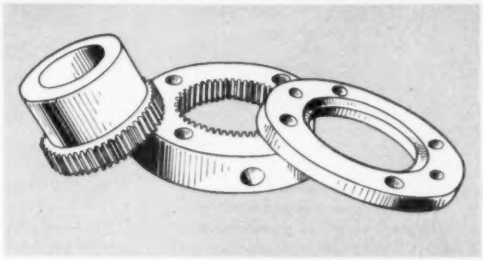
Once again referring to Fig. 9, note the compensating member is a floating inner sleeve, which engages the externally geared hub and the internally geared outer sleeve. This member takes a position to adjust for differences in alignment within the limitation of its design. It offers no resistance to the free movement of connected shafts; consequently it cannot set up a thrust bearing load.

Still another gear-type coupling is

COUPLINGS THAT ARE DESIGNED FOR HORIZONTAL AND VERTICAL DRIVES



12 Female portion of coupling is a synthetic material that is not affected by temperature, oil, water, gasoline and many acids. It is light in weight in addition to being good electrical insulator. No parts project after unit is assembled



13 Designed for vertical drive with hanging load having an angular deflection up to 3 deg. Will handle hanging load up to 8000 lb. Male gear is machined from cast steel while female part is cast iron. Lubricated through side fitting

shown in Fig. 10. Generally speaking, this type is particularly adaptable to those applications involving exceptionally high speed. At each end of this coupling the sleeve is closed and sealed to the hub by a special oil-resistant synthetic-rubber seal ring. Once again centrifugal force causes the oil to assume the form of an annular ring inside the sleeve, maintaining an oil film between the engaged gears.

Vertical Types. Coupling in Fig. 11 is designed for vertical use and is provided with but one set of engaging gears. Moving contact occurs only at point where teeth from upper hub engage the sleeve.

Still another design, suitable for vertical drive with a hanging load, is shown in Fig. 13. This particular unit performs satisfactorily with a misalignment in the drive of 1.5 deg on each side of the center line, or a total angular deflection of 3 deg. Coupling transmits 110 hp at 100 rpm. Hub, which is designed to take bores up to 5½ in, will sustain a hanging load up to 8000 lb. Not shown in the illustration is the lower rigid flange, available in either cast iron or steel.

Floating Shaft. It is accepted practice to locate driving motors for rolling mills in closed motor rooms while the driving shafts extend through the wall into the mill room. In this way all dirt, grit and heat are retained in the mill room while the motors operate efficiently and continuously in a cool, clean motor room, frequently in the presence of washed air. This case is illustrated in Fig. 16. Note that two flexible couplings are used with a floating shaft between.

The same idea is adopted where it is necessary to compensate for large misalignment. Length of floating shaft determines somewhat the degree of misalignment that can be handled, a long shaft compensating for greater misalignment.

CHAIN COUPLINGS

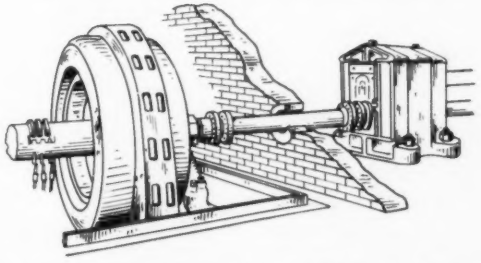
Several chain-type coupling designs are shown on following pages. Some differ in the type of sprocket used while in others the differentiating feature is the chain design.

Fig. 17 shows a chain coupling that uses but one pin to fasten the chain. Notice the combined cylindrical and convex rollers. Chain pins can bend, permitting the coupling to accommodate misalignment and absorb torsional shock loads. Coupling is designed to accommodate parallel misalignment as the pins bend in the direction of misalignment while the whole chain continues to retain a snug fit on the sprocket. Manufacturer recommends covers with this coupling to retain the light-grease lubrication.

Unique feature of the chain coupling in Fig. 18 is the divided rollers that make up the chain. Once again the assembly consists of two sprocketed coupling halves, connected by a steel-roller chain, which combines advantages of double-roller chain, with the rugged, simple construction of single-width chain.

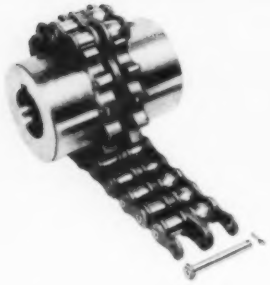
Silent Chain. Various types of chains are used extensively for transmission of power and speed conversion. Their efficiency as a

ANOTHER USE FOR THE FLOATING SHAFT

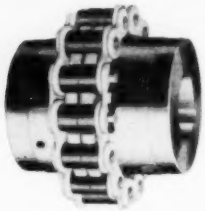


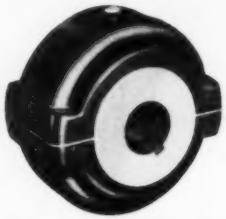
16 Motors for rolling mills are often located in closed motor rooms with drive shafts extending through wall to the mill room. Dirt and grit are retained in main mill room away from motors. This is another use for floating shaft, in addition to handling excessive misalignment

FLEXIBILITY WITH CHAIN AND SPROCKET DESIGN

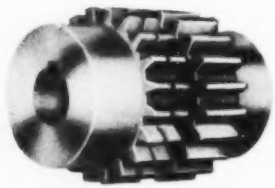


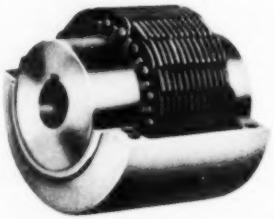
17 Convex roller maintains contact on sprocket under misalignment. Pins are designed to bend, permitting unit to absorb shock load and misalignment



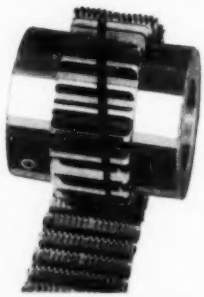


18 Divided rollers provide independent contact for each coupling sprocket. The revolving casing at right offers safety to operator and, in addition, protects coupling and holds lubricant. Cork seals are used at each shaft opening to prevent lube leakage, yet allow for end float and flexing of the coupling halves





19 Here's a sprocket design that's used with silent chain. The chain, with its single-pin joint, has a special link to speed disconnecting. Split aluminum cover is used to ensure adequate lubrication in addition to safety. After the coupling is installed, the cover is filled with grease through pressure fitting



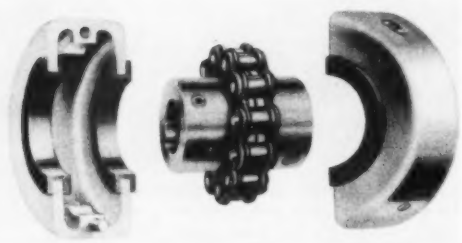
20 Steel pinion is cut diagonally to permit using full width of chain under tension. Available in ten sizes to 600 hp and speed range to 3600 rpm

power-transmission medium compares favorably with any type or method of positive driving. The term silent chain usually refers to an inverted tooth chain constructed of specially formed strip-steel links. Silent chain operates on clutch-tooth steel or cast-iron sprockets.

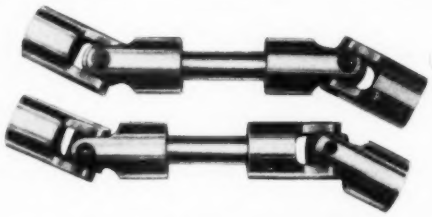
Referring to Fig. 19, notice the silent chain that is used in connection with the flexible coupling. One of the features of this coupling is the chain guide link, which fits into a groove on one sprocket. This keeps the chain in place and any lateral motion is taken up on the other sprocket hub.

Once again unit stresses on sprocket teeth are reduced to a minimum by using a large number of contact points between links of chain and sprocket teeth. When installing this type of chain coupling remember that the finished flat faces of sprocket halves simplify shaft alignment. Before installing chain be sure the two halves are as close together as possible without actually coming in contact. Then with two halves in place and shafts in line, as checked by a straight edge across sprocket top, wrap chain around and connect with a through pin held in place by a cotter pin.

The two halves of the split covering case can then be filled with a light grease and put in place. It is well to use enough grease so it will be forced out when the case is pulled together. Thus lubrication of all parts is ensured, even with high-speed operation, which would tend to throw grease to the outer part of the case if it is only partly filled. Chain couplings should not be used without covers except for intermittent service or at low speed.

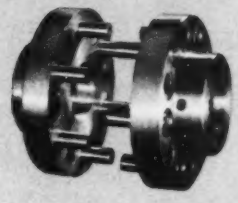


21 Solid rollers span sprocket teeth in this design. When lubricating, fill both covers with grease and squeeze into position. Use machine oil if coupling is operated without covers. The cover may be removed without disturbing machine

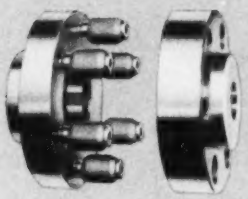


22 These universal joints will operate through an angle of 37 deg although recommended maximum is 15 deg. When installing it is important that joints be positioned correctly. Correct assembly is on top

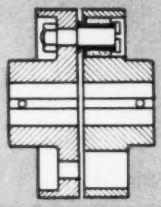
PIN-TYPE COUPLINGS CONNECTED THROUGH A YIELDING ELEMENT



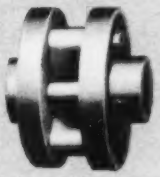
1 Cushioned bushing will take shock loads and misalignment. Flanges may be plated or made from metals to suit operating conditions



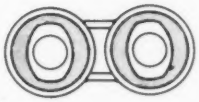
2 Here we have the pin rather than bushing wrapped in a cushion. The bolt within rubber bushing is crowned to distribute load equally

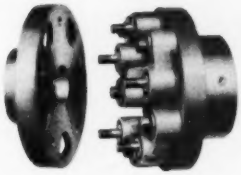


3 Mount either coupling half on the driving shaft, leaving sufficient space alongside the shroud so pins can be removed when disconnecting



4 Leather belt weaves between pins to take up shock loads and slight misalignment. Pin-and-belt type used for high-speed and heavy-duty jobs





5 Rubber bushings and pin blocks above used in coupling to right. Bushings, joined by the metal link, connect between driving and driven flanges; link forms floating member

USING BOTH PRINCIPLES

Couplings described in the past seven pages attain flexibility by either of the two basic principles we outlined initially. First group covered those whose flexibility depended on a yielding element placed between the two solid coupling halves. Second group included those utilizing a sliding element or mechanical design for flexibility. Couplings in this third group combine both these basic principles in their design.

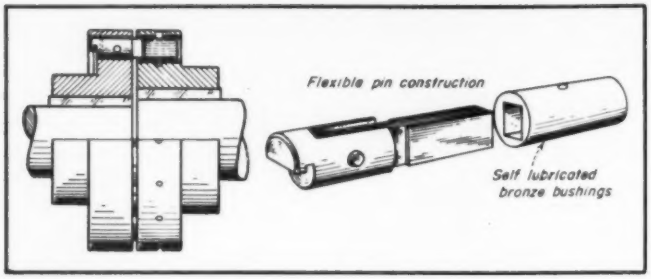
The coupling construction in Fig. 1 has pins on both coupling flanges, which slide in rubber-bushed self-lubricated bronze bearings on opposite halves. End float is handled by looseness of fit rather than flexibility of an intermediate element. On the other hand, angular and parallel misalignment are taken up by the rubber that surrounds the bronze bushing.

Closely akin is the coupling in Fig. 2. Its pins are covered with rubber, hence they carry the yielding material. The rubber not only absorbs shock but provides electrical insulation between driving and driven unit. One of the features of this coupling is the use of a crowned bolt, distributing stresses on the bolt's surface. As a result, the rubber bushing is subject to lower unit pressures.

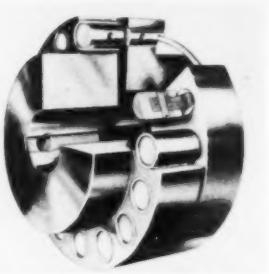
Still another design is shown in Fig. 5. This coupling has two rubber cushions inserted between the driving and driven coupling halves. One of the features of this particular design is the construction of the block surrounded by rubber. External oval shape of block assures on shaft misalignment an equal amount of rubber cushioning. When this coupling is overloaded the rubber is squeezed out against the flange and washer, entirely filling the space. Since this rubber is essentially non-compressible when confined in this manner, no further deflection takes place under additional load. This particular feature prevents the rubber bushing material being overstressed.

Cross section of a bushed-pin type is shown in Fig. 3. Lateral movement is taken care of by the sliding action of the rubber bushing

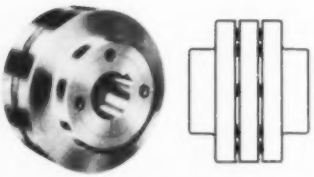
DESIGN FEATURES OF COUPLINGS THAT HAVE FLEXIBLE STEEL PINS OR A



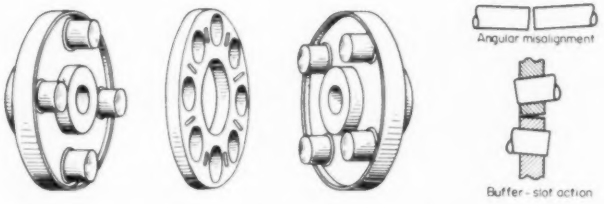
6 Copper-coated laminated-steel pins slide freely in the self-lubricated bronze bushings allowing end float. One end of flexible-pin unit is held fast to the keeper by welded cross pins; other end has bearing strips welded to each outside spring. Retaining ring holds all keepers snug. Pins and bushings are replaceable



7 Each laminated-steel pin unit has two cylindrical keepers, one being free to move laterally in bronze bushing. The laminations swivel on keeper cross pins



10 Nonmetallic composition disk fits between pin flanges. Inner sleeve grasps the shaft like a shrunk-on fit because of the tapered lock bushings



11 Each buffer slot in leather disk will close on sudden overload, protecting transmission system against damaging strains. Slots will also close when unit compensates for parallel and angular misalignment. Because leather disk transmits all power under compression rather than tension, life of the disk is lengthened

through a hole in end flange. Angular and parallel misalignment is taken care of by deformation of the rubber bushing.

Belt-and-pin type is shown in Fig. 4. Its flexible medium is a leather belt. Unit, which is designed for high-speed heavy-duty work, is suitable for direct-connecting motors with pulverizers, shredders and heavy-duty units.

Uniqueness of the coupling in Fig. 6 centers about the steel-pin construction. The laminated-steel pins are coated with a rust preventive. Each pin is covered with a hard-steel bearing strip welded to the outer springs and fitted to slide into the self-lubricated bronze bushing on the opposite coupling flange.

Coupling in Fig. 7 may be classified in the same family with Fig. 6. Once again we have a coupling consisting of two solid flanges connected by means of flexible pin units to compensate for misalignment. Pin flexibility does not come into the picture in end-float movement. Each pin unit consists of two slotted steel keepers or bushings, one on each side of the pin assembly, and a number of steel laminations. The laminations are free to swivel on cross pins, which hold them firmly in the keeper. One end of each pin unit is held to the flange by a spring-retaining ring. This leaves the other end free to move laterally in bronze bushings located in the opposite flange. In addition to compensating for misalignment, pin units provide a spring cushion for shock loads and vibration.

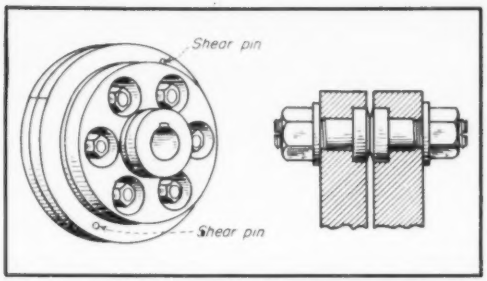
Shear-Pin Couplings. Shear pins are sometimes used as part of a coupling to protect connected machines from overloading. The shear pin itself may be classified as insurance against damage to connected machines. Cost of shear pins, which can be replaced in a few minutes, is trivial in contrast to a possible broken shaft or damaged gears.

Flanges of coupling in Fig. 8 are protected from damage when pin shears by two hard-steel bushings mounted in each flange. Bushings insure a clean shearing action on the pins rather than a break or tear.

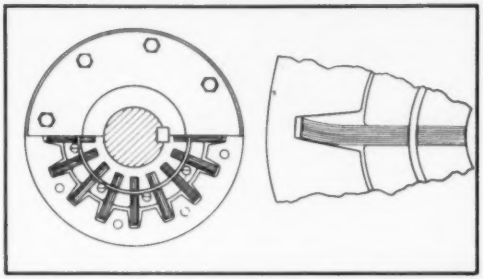
Single shear pin is frequently all that is needed, particularly in the smaller sizes of couplings. Should load conditions warrant, many couplings can be equipped with several shear pins. As a rule-of-thumb, shear-pin capacity often falls within 250 to 300% of the normal operating torque requirements. Often a trial-and-error method must be used to find the correct shear-pin size. Many manufacturers supply couplings for such experimental work, usually at no extra charge. A typical shear pin is shown in the cutaway view, Fig. 8.

Free end-play, even to the extent of 6 in., is one of the features of the flexible-pin-type coupling in Fig. 9. In addition to the flexibility provided by the radial-pin-type spring, provision is made to transmit power from a large shaft to a smaller without being forced to go into a larger-sized coupling. This feature is incorporated by increasing the internal diameter of one flange to take the oversize bores. Tapered slot construction at the points where the radial

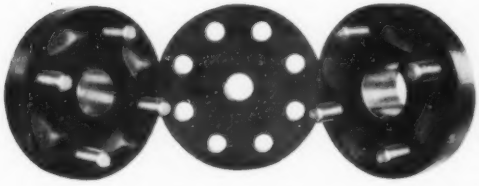
PLIABLE DISK INSERTED BETWEEN THE RIGID FLANGED HUB MEMBERS



8 Shear-pin couplings protect machines from overload damage. Two different shear pins are shown. When pin shears, the flanges are protected by two steel bushings that insure a clean cutting action of shear pin rather than break or tear

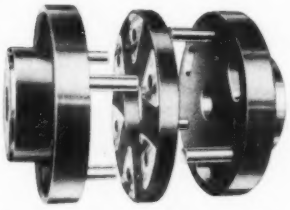


9 Flexible driving spokes are arranged at right angles to shaft. In addition to compensating for misalignment and permitting end float, coupling protects connected machines against shock loads. Radial stops give overload protection



12 Flange and leather disk of this coupling are balanced, insuring smooth operation at maximum speed. Flanges are malleable-iron castings having wide rims to aid in proper alignment. Cold-rolled steel pins are press-fitted in flanges

13 Pins extend beyond fabric disk to recesses in opposite flange assuring contact through entire disk thickness. Disk holes, slightly larger than pins, permit the coupling to adjust for small misalignment and shaft end movement



14 Metal bosses encircle all holes in the vulcanized rubber-fabric insert. Coupling will absorb impulse loads; it is unaffected by moisture, dust or grit

15 Unit has an oil-resistant synthetic-rubber insert that fits the pronged end flanges. Coupling is available for use with shafts $\frac{3}{8}$- to $1\frac{1}{2}$-in. diameter. There is no need for lubrication and the coupling is not harmed by oil, dust or dirt. Machined flanges have a standard-cut keyway and conventional setscrews

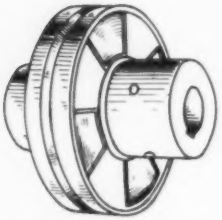
springs leave and enter both flanges increases the area of contact and hence maintains approximately constant pressure per unit of area.

Unique overload protection is provided on this coupling through the use of solid steel stops. Two or more of these stops are used, inserted in the same manner as the regular flexible pins. Since they are shorter than the laminated pins, they do not come into action until a heavy overload is being carried, when they make contact and prevent further strain on the springs. Their action may be compared to that of the rubber boosters on the axles of automobiles, which come into play when the springs have been flexed to their safe limits, preventing further movement.

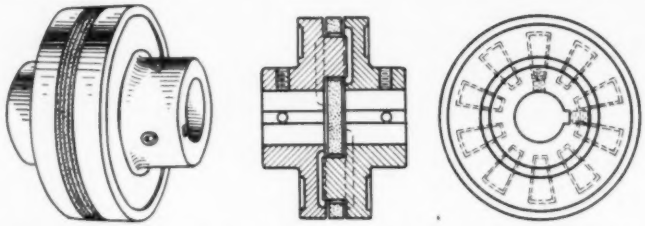
Disk Design. A nonmetallic composition disk fits between the pin-type coupling halves in Fig. 10. Coupling is fastened to the shaft by squeezing action of split bushing. This is accomplished by three threaded locks, which expand the bushing. This is in addition to the conventional key method of fastening. Result is a fit approaching the firmness of a shrunk-on job.

Disk of the pin-type coupling in Fig. 11 has buffer slots inserted between the through holes. These slots result in increased flexibility as shown by the cross-sectional view illustrating how slots close under angular misalignment. In addition, they prevent noise, dampen vibration, and keep the disks from distorting. Under overload, the buf-

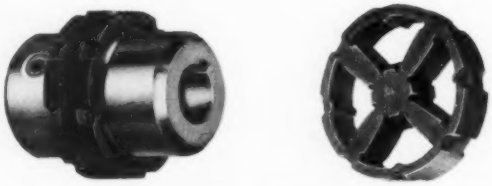
THESE COUPLINGS TAKE SHOCK LOADS AND MISALIGNMENT THROUGH THEIR



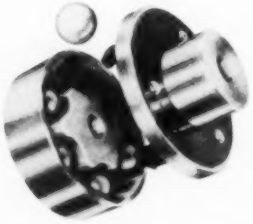
16 Lugs of disk sides fit into spaces in metal flanges. Since flanges and disk must make firm contact, unit is best suited for steady, nonoscillating loads



17 In contrast to coupling in Fig. 16, this unit has lugs protruding from the flanges into the flexible disk. Coupling halves should be separated a distance equal to or slightly greater than maximum shaft endplay. Coupling assembled by working both flanges together after disk is inserted; fasten with set screws



20 Rubber insert between coupling flanges is built around wire base for additional strength. Two prongs of each flange are set in rubber disk 90 deg. out of position with respect to each other. A similar coupling is available without wire support in disk; insert is simply a hubbed member



21 Coupling consists of spider, flange, ball-retaining cover and six balls of synthetic rubber. Balls transmit all torque, yet absorb shock and vibration

fer slots close to protect the shaft, keys, ball bearings and other parts of the transmission system against damage and strain. The leather disks are laminated for increased strength and each layer is of waterproof leather bonded under high pressure.

Suitable for lighter loads and high speeds, the coupling in Fig. 12 is particularly adaptable to drives such as direct-connected centrifugal pumps, woodworking machinery, speed reducers, etc. Construction is simple, consisting of two flanges with steel pins pressed in and joined together through a leather disk.

Unit in Fig. 14 is designed for heavy-duty applications in the range from 3 to 100 hp. In this design the insert is vulcanized rubber fabric. Synthetic-rubber insert in the coupling illustrated in Fig. 15 is oil resistant. This coupling is available for connecting shafts 3/8 to 1½ in. in diameter.

Nonmetallic disk fits between the metal flanges of coupling illustrated in Fig. 16. Disk, which has lugs on each side that fit into corresponding spaces in the flanges, is made from oil-resistant compound for couplings up to 10½-in. diameter. Leather is used in the larger-size disks. Lugs are reinforced with steel plates which in turn are bolted through the disk.

Since disk and flanges must be in firm contact, coupling is best suited for handling steady loads where excessive oscillation is absent.

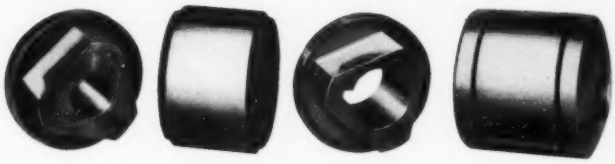
A wide range of cushion materials can be supplied with the couplings shown in Fig. 19 to suit the particular load being served. These range from a high-grade brake-lining material for heavy shock loads to armored rubber cushions suitable for any speed where there are wide fluctuations in load. Note that the cushions are individual free-floating elements held in position by the inside steel sleeve and removable steel collar. When in operation, one half of the cushions are idling (except for reversing load); hence there is always a set of new cushions in the coupling. Cushions can be interchanged by simply sliding off the outer collar, leaving the coupling proper intact.

Metal rings are located within the rubber-insert coupling shown in Fig. 20. And both coupling halves fit snugly in the spider construction of the rubber insert.

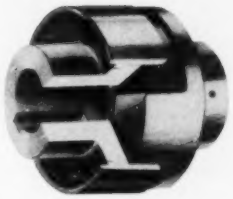
Floating center element of the unit in Fig. 22 connects with the two end portions through a combination of resilient and antifriction members. Antifriction members come directly in contact with interlocking jaw surfaces, while resilient members are located between the aforementioned antifriction construction. Floating center coupler, with its antifriction and resilient members, is free to move as working conditions require. Both antifriction and resilient members are replaceable.

Fig. 21 shows a coupling consisting of a spider, flange, ball-retaining cover and thick synthetic-rubber balls. Balls come into play in transmitting torque, absorbing shock and vibrations, but do not transmit end thrust. Misalignment is easily detected after coupling is in service since both halves are machined to the same diameter. If serious misalignment crops up after installation, the replaceable rubber balls rather than the coupling or machines are damaged.

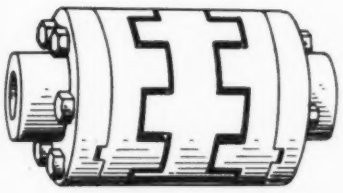
LEATHER OR RUBBER DISKS, RUBBER BALLS OR WINDING STEEL GRIDS



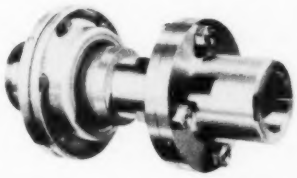
18 Shock-absorbing center ring fits over triangular flanges that are keyed to shafts. Smooth coupling surface adds to appearance in addition to preventing possible accidents when shafts are rotating. Yielding element extends from the replaceable center ring to under side of the flanged lip of both end members



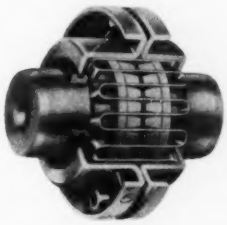
19 Cushion substance ranges from brake-lining material to armored rubber, depending on nature of load. Cushions replaced in a matter of minutes



22 Floating-center coupler separated from end members by anti-friction and resilient coverings. Unit acts as an insulator between motor and machine



23 Spacer-disconnect used with unit, Fig. 24. Spacer permits removal of pump impeller, packing gland or motor without disturbing foundation bolts



24 Steel grids wind snugly into curved grooves cut in coupling flanges. The grid bears on grooves in proportion to load and slides freely for end float

Steel Grid. A flexible-steel grid is the connecting link between both halves of the coupling in Fig. 24. Of all-steel construction, unit consists essentially of two flange steel hubs, a specially tempered-steel spring forming a cylindrical grid and a steel shell cover. Peripheries of the hubs are slotted to receive the spring member, with hub slots curving inwardly toward each other.

Spring grid is a flexible member. When it is bent around the arc of the grooves, stresses in the springs are practically constant throughout the elastic range of the coupling. Spring fits into the groove closely at the outer end, giving a long, free span between the points of support at light load. As load increases, area of contact between teeth and spring member increases, thus automatically decreasing the span.

Coupling is packed with grease and enclosed in a steel shell that acts as a lubricant retainer and guard. Once again, these couplings are made in all sizes and are flexible in all directions. Because the grid member slides freely in the lubricated grooves, the unit permits unrestrained end flow for the shaft of both the driving and the driven members, or of either one. If it is desired that end float be restricted, provision can be made to limit it.

Spacer that may be used in conjunction with the aforementioned coupling is shown in Fig. 23. This is handy when it's necessary to remove a pump impeller, packing gland, or seals on driving unit without disturbing foundation bolts and driven unit, in addition to convenience in disconnecting motor when desired.

Flexible Shafting. Flexible-shaft couplings are used to connect two shafts where the terminals are relatively close together but are out of alignment. Frequently these couplings do not require a sheath or casing unless the length to diameter ratio is excessive.

Flexible shafting handles two basic functions: It transmits power as does a regular shaft and it may transmit axial motion, as in push-pull type control. Generally speaking, it can handle small amounts of power at either high or low speeds. Flexible shafting is also used where either the driven or driving element is continually moving with respect to the other. This is the case with many portable tools.

Most flexible shafting is surrounded with a casing to act as a guide, in addition to protecting the inner core from dirt and abrasion. As a general rule a wire winding forms the foundation sheath around which the outer covering is wrapped.

Considering we have departed from flexible couplings, as we have defined them, it would not be out of order to say a few words about universal joints. Strictly speaking, flexible shafting and universal joints are somewhat outside the scope of this special section; nevertheless, they are often the solution where the shafts to be connected were out of line originally. The universal-joint illustration on p 96 Fig. 22, shows the right and wrong way to install. When using two single universal joints, it is important that they be positioned correctly. Although the particular joint shown will operate at an angle of 37 deg, it is recommended that the operating angle be limited to 15 deg for best results.

DETERMINING SIZE

When selecting flexible couplings for a given application there are many factors to consider. In addition to points covered on pages 88 and 89 of this Special Section, coupling size is of primary importance.

Rating. Couplings are usually rated in hp per 100 rpm. Units rated 5 hp at 100 rpm may often be used to transmit 25 hp at 500 rpm. Such is the case when operating conditions are favorable, as with an electric motor driving a blower, or a generator supplying a fairly constant load.

Since conditions of load and drive vary widely, a *service factor* must be used. Table on this page lists the service factors used by one flexible-coupling manufacturer. Unfortunately, these factors cannot be taken as standard since other manufacturers use different ones for their couplings. Hence a safe rule to follow is to use the service factor recommended by the manufacturer of the coupling you are considering.

Capacity. Coupling capacity in hp per 100 rpm required for a given application can be determined by the formula:

$$\text{Coupling rating} = \frac{\text{Hp} \times \text{F} \times 100}{\text{S}}$$

Where Hp = horsepower to transmit
F = service factor
S = coupling speed in rpm

Let us take the case of selecting a coupling for a 25-hp 850-rpm motor, driving a belt conveyor. Checking with the table we find a service factor of 2 is given for this drive. At 100 rpm the coupling rating will be (25x2x100)÷850 = 5.9 hp. Next step is to consider the shaft size. If, after checking coupling dimensions, it is found that maximum bore for the 6-hp size is smaller than the shafts on which it is to be used, select larger coupling to accomodate shaft size. It is well to err on the side of over-capacity since there is little possibility of trouble arising on that score.

One of the toughest jobs a coupling handles is linking a reciprocating load, such as a steam engine driving a compressor. Here the coupling is subjected to shocks from power source and load. In this case the table recommends a service factor between 9 and 11. The higher factor is used for the most unfavorable condition; for instance, where a single-cylinder engine drives a single-cylinder compressor.

TYPICAL SERVICE FACTORS FOR FLEXIBLE COUPLINGS

Drive	Application	Service factor
Turbine	Centrifugal pumps, fans	1.25
Turbine	Generators	1.5
Motor	Centrifugal pumps, fans	1.5
Motor	Belt conveyors	2.0
Motor	Duplex and triplex pumps	3.5
Motor	Screw conveyors, hoists, etc.	4.0
Motor	Compressors	6.0
Engine	Centrifugal pumps	3.0
Engine	Variable-load generators	5.0
Engine	Triplex and duplex pumps	5 to 6
Engine	Fans	8
Engine	Compressors	9 to 11

Consult Manufacturer. When in doubt about proper coupling size, it is best to get the advice of the manufacturer whose coupling you plan to use. Many manufacturers supply a questionnaire with their catalogs to assist both design and operating engineer in making a wise selection.

Common Errors. One of the commonest causes of trouble sprouts from selecting couplings too small for the application. This often results from not giving proper attention to load characteristics and the power unit. This is illustrated by noting that our table lists a service factor of 1.5 for couplings on motors driving centrifugal pumps and fans. Now if the load is a triplex or duplex direct-acting pump, a service factor of 3.5 is used.

Centrifugal pumps and fans under normal conditions represent a fairly steady load and cause little coupling wear. A plunger pump, on the other hand, represents a load that varies with the position of pistons and is continually subjecting coupling to shocks. Consequently, the coupling selected for the latter application must be large enough to meet the more severe conditions.

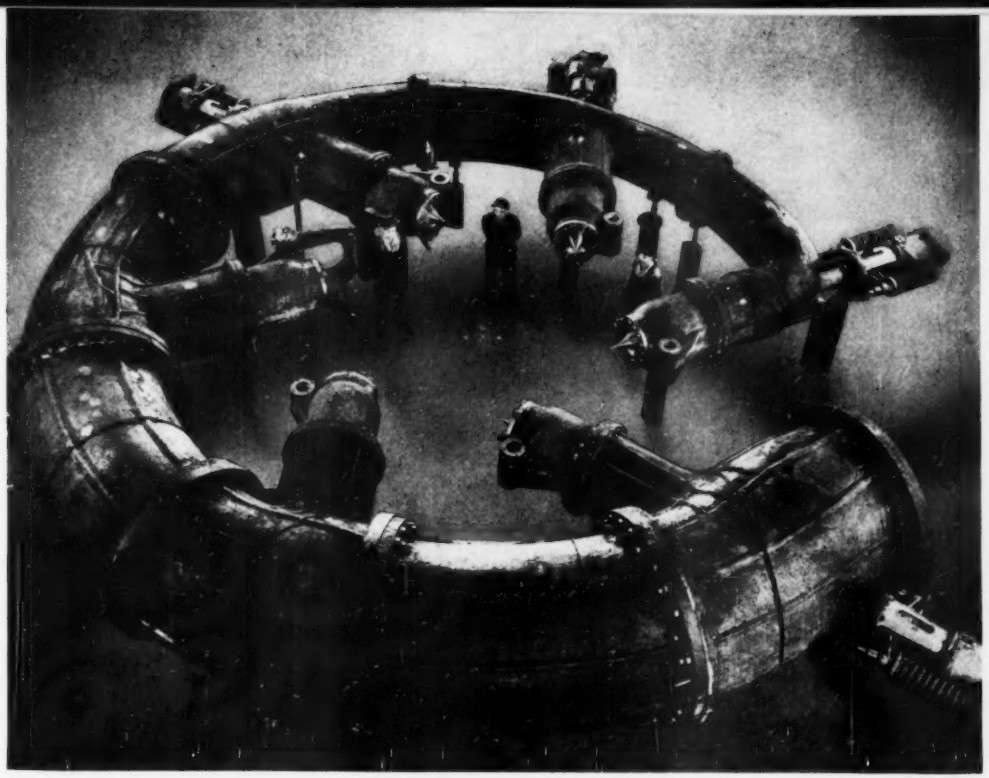
The manufacturer should be told the kind of machines to be connected, hp and speed (both normal and maximum if there is considerable variation) and size of both shafts and keyways. Any special conditions should also be included, such as a flywheel and its location, reversing service, space limitations, unusual temperatures, excessive moisture, fumes, etc.

Where a coupling is to be used for reversing service, careful consideration should be given to the type selected. For instance, couplings that have considerable backlash should not be used for this application. If reversals are frequent, a coupling large enough should be selected to stand the service. Where equipment is subject to braking action, such as on hoists and cranes, account must be taken of these conditions and a proper service factor used. Once again, use the service factors recommended.

ACKNOWLEDGMENTS

During preparation of this special section liberal use was made of the technical data supplied by flexible-coupling manufacturers. Hence POWER is indebted to the following concerns for their fine cooperation:

Ajax Flexible Coupling Co Inc, American Flexible Coupling Co, Bond Foundry & Machine Co, Boston Gear Works, Brown Engrg Co, Brownstein Mfg Co, Certified Flexible Couplings, Chain Belt Co, Continental Diamond Fibre Co, Crocker-Wheeler Elec Mfg Co, DeLaval Steam Turbine Co, Diamond Chain Co Inc, Dodge Mfg Corp, F A B Mfg Co Inc, Falk Corp, Farrel-Birmingham Co Inc, Fawick Airflex Co Inc, Frederick Iron & Steel Inc, Gear Grinding Machine Co, Jeffrey Mfg Co, W A Jones Foundry & Machine Co, Koppers Co Inc, Link-Belt Co, Lord Mfg Co, Lovejoy Flexible Coupling Co, Morse Chain Co, Philadelphia Gear Works Inc, Poole Foundry & Machine Co, Ramsey Chain Co Inc, Smith & Serrell Inc, Sprout, Waldron & Co, Stephens-Adamson Mfg Co, Thomas Flexible Coupling Co, Union Chain & Mfg Co, Universal Gear Corp, John Waldron Corp, Whitney Chain & Mfg Co, T B Wood's Sons Co



SIX-NOZZLE JET ASSEMBLY for one of three 62,000-hp 1130-ft head impulse waterwheels being installed in Bridge River development of BCER Co, Vancouver. Tested to 935 psi, it has 3/4-in. steel walls, and is 66 in. in diameter at intake end

Six-Nozzle Impulse Waterwheels

► AMONG THE INTERESTING FEATURES of the British Columbia Electric Railway Co's Bridge River plant are the 6-nozzle vertical-shaft impulse waterwheels and the hydraulically operated spherical-plug penstock valves. When completed the plant will have ten 62,000-hp 300-rpm 6-nozzle vertical-shaft impulse wheels operating under a 1130-ft head.

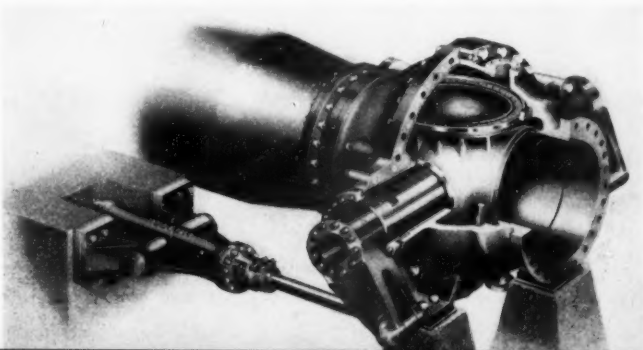
Each wheel connects to a 50,000-kva 0.90-pf 60-cycle generator. First unit went into operation October 1948, and two more go into service this year. The waterwheels were designed by Pelton Water Wheel Co and built by Vancouver Engineering Works. Generators are by Canadian Westinghouse Co.

These vertical units reduce powerhouse construction costs as the vertical turbine-generator arrangement saves floor space and the impulse turbine does not need a draft tube.

Pelton 54-in. spherical plug valves (lower photo) have a straight-through cylindrical passage of the same diameter from its intake to outlet, thus reducing friction loss in it when open to that of an equal length of straight penstock.

Operating mechanism includes two hydraulic servomotors, each mechanically connected to a lever on opposite ends of the valve shaft. Valves are operated by water from the penstocks in the hydraulic cylinders. Safety devices are so arranged that a valve cannot be opened until pressure is equalized across it by a bypass. Plugs rotate through 90 deg to open or close.

HYDRAULICALLY OPERATED spherical-plug penstock valve in open position is 54 in. in diameter, has a straight-through cylindrical passage to reduce flow friction loss



SPONTANEOUS ACCEPTANCE

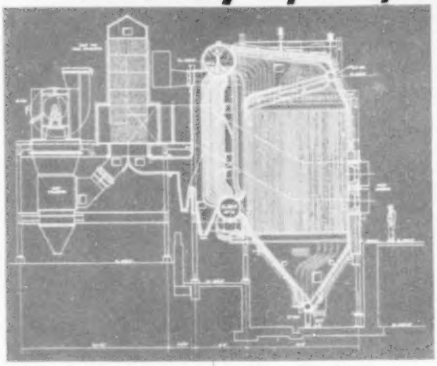
already 8,620,000 lbs. of steam

All of these companies have ordered Riley Single Header Hopper Bottom Units

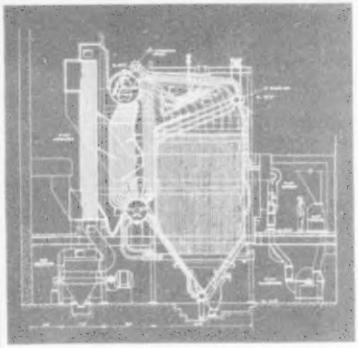
Carnegie Illinois Steel Corp.
Chase Brass & Copper Co.
Celanese Corp. of America
Norton Company
Esso Standard Oil Co.
Bird & Sons
American Viscose Corp.
Great Lakes Steel Corp.
Northern Paper Mills
Chevrolet Motor Co.
Waldorf Paper Products Co.
Cities Service Corp.
Hooker Electrochemical Co.
Calumet & Hecla Consol. Mining Co.
Riegel Textile Corp.
Savannah Sugar Refining Co.
Monsanto Chemical Co.
New Orleans Public Service Co.
Gould Paper Co.
Champion International Co.
Central Ohio Light & Power Co.
Otter Tail Power Co.
Upper Michigan Power & Light Co.
Ware Industries
C. H. Masland & Sons
Milwaukee Forge & Machine Co.
City of Danville, Va.
City of Holyoke, Mass.
City of Los Angeles, Calif.
City of Rochester, Minn.

These Consultants have engineered Riley Single Header Hopper Bottom Unit projects

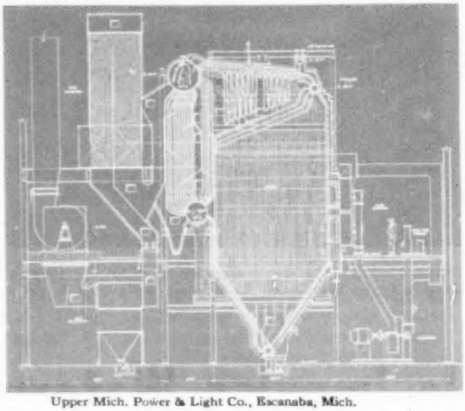
Sargent and Lundy
Ebasco Services, Inc.
United Engineers & Constructors
Day & Zimmerman, Inc.
Chas. T. Main, Inc.
Vern E. Alden
Rust Engineering Co.
Albert Kahn
Douglas M. McBean
Sill and Warrington
W. I. Barrows
Arthur G. McKee & Co.
M. W. Kellogg Co.
Harrison G. White
Oscar A. Kiss
Helmick, Edeskuty & Lutz
McClintock & Craig
Egle & Compf, Inc.



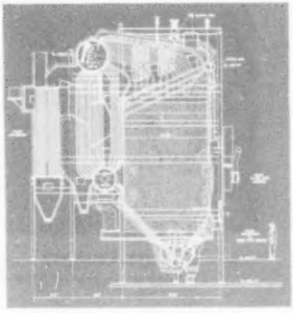
Hooker Electrochemical Co., Niagara Falls, N.Y.



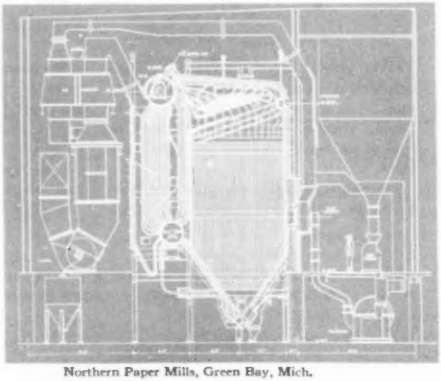
Champion-International Co., Lawrence, Mass.



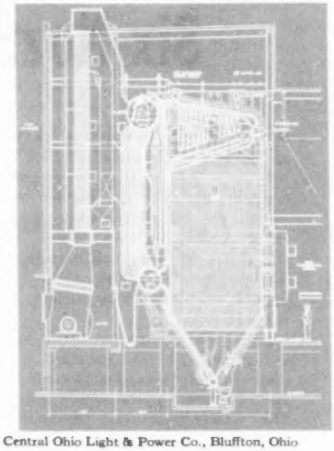
Upper Mich. Power & Light Co., Escanaba, Mich.



Norton Co., Worcester, Mass.



Northern Paper Mills, Green Bay, Mich.



Central Ohio Light & Power Co., Bluffton, Ohio

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Cleveland · Detroit · Chicago · St. Louis
Cincinnati · St. Paul · Salt Lake City · Pittsburgh · Kansas City · Denver · Seattle · Portland · Los Angeles
Houston · New Orleans · Atlanta · Memphis · Tulsa

BOILERS · PULVERIZERS · BURNERS · STOKERS · SUPERHEATERS · FLUE GAS SCRUBBERS

# of this Unique Riley design was only natural

per hour capacity installed or on order

You save by installing Riley Single Header Hopper Bottom* units by . . .

reducing height of building

Over-all height is at least five feet lower than the conventional unit—either resulting in large saving in building cost or permitting installation of a higher capacity unit in existing building.

eliminating cost of separate hopper

The requirement of a separate ash hopper is completely eliminated not only saving that cost but also the cost of foundation or supporting means.

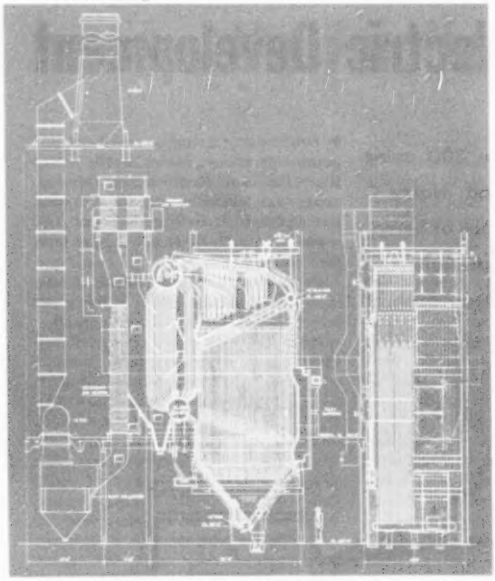
eliminating cost of seals and drip castings

Cost of seals between the steam generating unit and ash hopper and cost of alloy drip castings as well as maintenance of these items is eliminated.

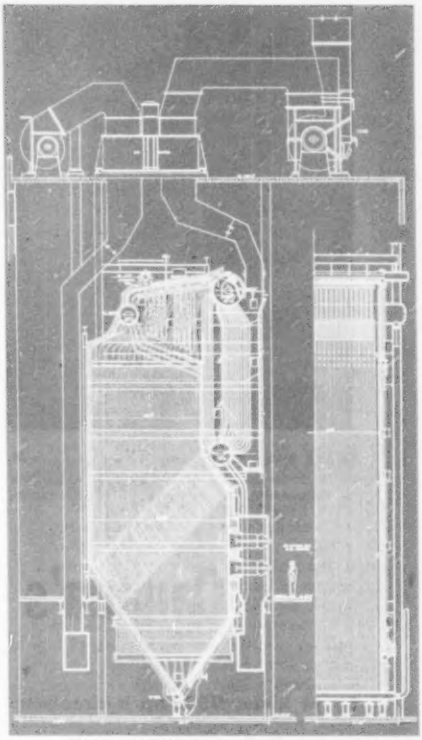
without sacrifice of a single operating advantage

These significant investment savings result without sacrifice of a single operating advantage. Users invariably report entire satisfaction and ease of ash removal with Riley units of this design.

*Patent Pending



Otter Tail Power Co., Crookston, Minn.



New Orleans Public Service Co., New Orleans, La.

Here is what some users say about this Riley hopper design

"We are very definitely satisfied with this unit and certainly would not hesitate in installing another bottom of this type."
NORTHERN PAPER MILLS, Green Bay, Wisconsin

"We are so well pleased with this unit that a duplicate unit is now being installed."
HOOKER ELECTROCHEMICAL CO., Niagara Falls, New York

"If we were installing additional units we would not hesitate to specify the present type of hopper bottom."
GOULD PAPER COMPANY, Lyons Falls, New York

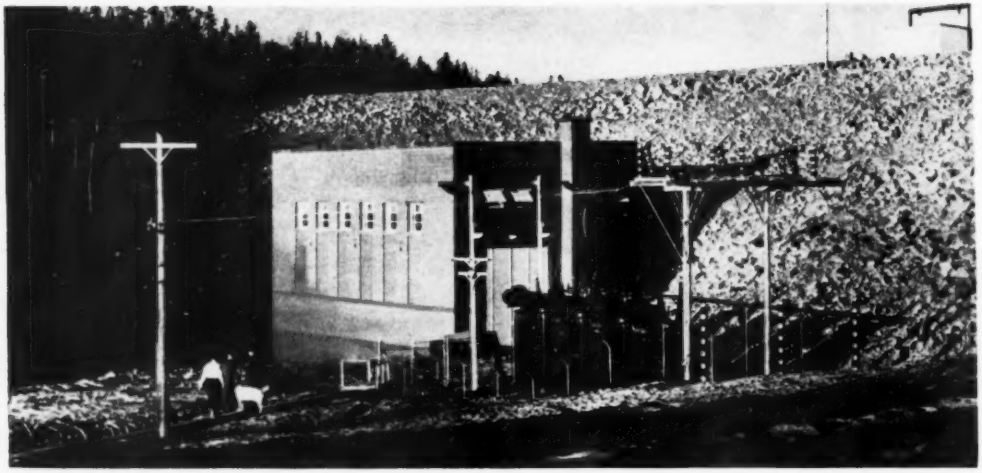
"We have had no difficulty in cleaning ash from the single header hopper bottom. Ash flows readily down the slope of the hopper."
CENTRAL OHIO LIGHT & POWER CO., Bluffton, Ohio

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS · WATER-COOLED FURNACES · STEEL-CLAD INSULATED SETTINGS · AIR HEATERS



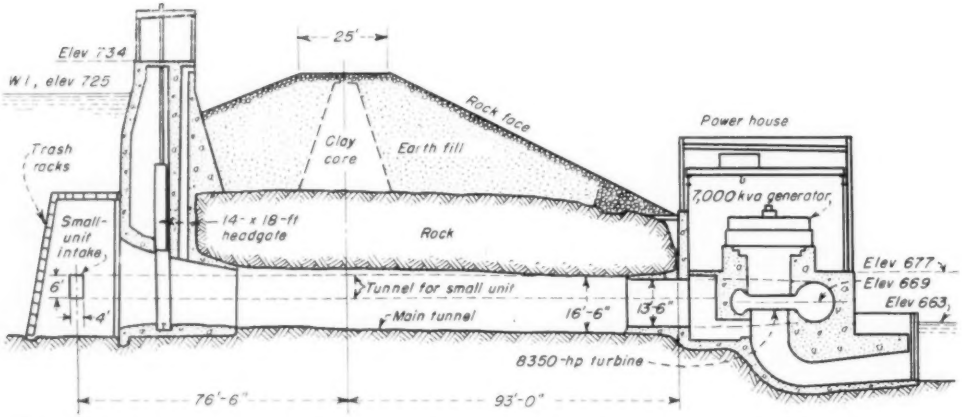
SNARE RIVER DAM, power house and transformer substation. Latter steps up generator voltage to 115,000 v for transmission to Yellowknife, 94 miles away. In this plant 9500-hp turbine operates under 56-ft head, has welded plate-steel scroll case and connects to a 7000-kva 3-phase 60-cycle 6900-v unity-power-factor generator with a direct-connected 90-kw exciter

Canada's Hydroelectric Development

Snare River, 9500-hp hydroelectric plant, is within 300 miles of the Arctic Sea, and 700 miles from the railroad. Harry C Plumber, Canadian correspondent, tells how 2000 tons of heavy power machinery, construction equipment and materials had to be transported by tractor train over frozen, barren country

► One of Canada's northernmost power operations, known as the Snare River Dam and Hydroelectric Development, was officially put in operation last October. It is 97 miles from Yellowknife, a gold, silver and copper mining center.

Compared to power-generating stations in Canada and the U. S. this plant



EARTH-FILLED DAM with rock facing and clay-core wall is 800 ft long at crest, 73 ft high, 420 ft maximum width at base. Construction required 43,000 cu yd of clay, nearly 100,000 cu yd of earth and 21,200 cu yd of rock fill on its face

INAUGURAL CEREMONY attended by (l to r) F Fraser, dist administrator, NWT; J M Wardle, chairman NWT Power Commission; K Muir, general manager, Giant Y K Gold Mines, and A F Totzke, chairman, board of trustees, Y K Administrative District

Invades the Far North

has a modest capacity. Its location is literally in the wilderness at latitude 63.5 deg, within 300 miles of the Arctic Sea. Plant and 94-mile transmission line, the latter crossing absolutely barren country, supply Yellowknife mines and their adjacent community of 4000 population or more as the sole customers.

Power-generating transmission and distribution facilities are subjected to extreme temperatures. These range from 60 F below zero, common in the long winters, to 90 F above, or higher, in the summer months.

Climate, the isolated location, and almost total absence of anything resembling highways fit for motor trucks imposed transportation obstacles without precedent in Canadian power development. A distance of 700 miles separated the Snare River power-plant site from the railheads at Waterways, Alberta, in summer and at Grimshaw in winter. From the former, which is 60 miles north of Edmonton, 1200 tons of construction and power equipment were moved in by tractor train. Other materials were taken in by water in summer and by freight planes.

Because of transportation difficulties all possible local construction material was used. This led to building an earth-filled main dam with a clay core and a rock facing on both the upstream and downstream sides. This dam closes the discharge of Big Spruce Lake and, by raising its level 45 ft from elevation 680 to 725, provides storage capacity of 133,000 acre-ft.

As shown in the drawing, the reservoir connects to the power house by a 16.5x16.5-ft tunnel driven in solid rock. Except for the headgate and powerhouse connections to it the tunnel is unlined. It runs nearly horizontal, with its center line 56 ft below normal forebay level. The intake works contain 14x18-ft steel headgate with its electric hoist and the trash rack. Both trash rack and gate are located deep under water to eliminate as far as possible trouble from ice and freezing.

The power house of steel-beam, concrete and cement-block construction contains 2400 cu yd of concrete. In winter, it is heated by an electric steam boiler and radiators, and in emergencies, by an oil-fired boiler.

Generating Equipment. Power-generating equipment includes a main and a service unit. The main turbine by S Morgan Smith, Canada, was originally rated 8350 hp. at 128.5 rpm and 56-ft head. Studies at the plant indicate that a 63-ft net operating head can be obtained at which the turbine can develop 9550 hp. Scroll case for a turbine of this type and head is normally formed in concrete, but because of local conditions plate steel is used. It is shop and field welded but the joints between the plates and cast-steel stay ring are riveted. Its intake, 13 ft 6 in. in diameter, connects to the tunnel by a short steel penstock of the same diameter.

A Woodward oil-pressure governor controls turbine speed. Main turbine connects to a Canadian General Electric 7000-kva 3-phase 60-cycle 6900-v unity-power-factor generator, with a direct-connected 90-kw 250-v exciter.

Generator output goes to a substation directly outside the plant. Here a bank of three 2500-kva self-cooled Canadian General Electric transformers step the voltage up from 6900 to 115,000 v for transmission over a 94-mile line to the step-down substation at Yellowknife.

If the main unit fails, a 150-kva generator driven by a 190-hp 900-rpm twin-runner horizontal-shaft Charles Barber turbine will provide power for making the repairs, light the power house and staff quarters.

An auxiliary oil-fired heating plant heats all buildings and supplies hot water in emergencies, as, for instance, when the main power-generating unit is shut down. A small gasoline-engine-driven plant supplies power for the oil burners and the heating system.

Because there will always be deep water over the racks and intake structure once the lake freezes over, little trouble is expected from ice. The intake and rack are so low that water flows from the bottom of the lake rather than its surface.

Construction of the Snare River plant by the Department of Mines and Resources provides one of the basic facilities for the industrial development in the area lying north of Great Slave Lake. Availability of this power should greatly encourage mining development, subsidiary and contributing industries in the Yellowknife area. Mining properties now in the expansion stage will be in a position to plan their mill construction and production schedules with the assurance of ample power.

The Montreal Engineering Co was the consulting engineers for the entire project, Sutcliffe & Co served as consultants on the transmission lines, and the Northern Construction-Mannix Companies, Ltd was the general contractor.

The plant went into operation on Oct 4, 1948, under direction of the Northwest Territories Power Commission, an affiliate of the Dominion Department of Mines and Resources. Power was turned on by James M Wardle, chairman of the commission in the presence of F Fraser, district administrator of

(*Continued on page* 110)

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Westinghouse Life-Line . . . industry's amazing new, all-steel motor . . . now completely eliminates the biggest element in the maintenance of motors and motor-driven equipment . . . the need for periodic motor lubrication.

Eliminated, too, are two of the most frequent causes of motor burnouts and lost time . . . overgreasing and undergreasing of motors. Life-Line motors are equipped with sealed bearings, pre-lubricated for life with a more-than-ample supply of specially-treated lubricant.

Correct lubrication and long life are assured ... machine outages are reduced... motor drive problems are simplified, since motors can be located without need for constant accessibility.

Added to Life-Line's outstanding advantages of plate-steel protection, improved windings and more compact size, *lifetime lubrication* is one more important reason for starting to convert, today, to Life-Line power. Standard ratings are available from stock—others on short delivery schedules. Ask your Westinghouse representative for price and delivery on your requirements, or write P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21495

Westinghouse

Life-Line

Motors

TRACTOR TRAIN IN NORTH. A distance of 700 miles separated Snare River hydroelectric power-plant site from railheads. Much of the machinery and construction material for this project was brought by traction trains like the one shown here

the Northwest Territories. K Muir, general manager, Yellowknife Gold Mines, Ltd, and A F Totzke, chairman, board of trustees of the Yellowknife Administrative District.

During the winter months, hauling freight into Canada's Northwest territories presents many problems. Tractor trains do much of the job. A standard train consists of a large tractor hauling twenty-eight 15-ton sleds and a caboose, which also serves as cook house and dining room. The trains are guided by an airplane, as above, to locate ice fissures and other danger spots. They run continually around the clock and any but the slightest grades must be avoided. Rough ice on the lakes is a continual problem.

Unexpected thaws, pressure ridges that push up as high as 20 ft, some over 100 miles long, form the greatest natural hazards. The route from Lower Hay River to Yellowknife is about 120 air miles. But dodging pressure ridges, avoiding rough ice areas, and calling at Fort Resolution lengthens the trip to nearly 200 miles. Aircraft spot the best routes and carry messages and repair parts. Above, an airplane checks the train to see if all is well and drops a map with routes around pressure ridges. *National Film Board photos.*

TRACTOR TRAIN IN YELLOWKNIFE. Photo shows the train after a 150-mile trip from the Lower Hay River across Great Slave Lake. Because of heavy snow and an overload it took over a week of continuous operation to complete the wintry journey

"Give us the tools . . ."

Now is the time to *FIGHT SOCIALISM* in Washington

Do we want to follow Britain down the economic skids?

We Americans face that question today. For we are being advised by Administration economists in Washington to take the course which destroyed Britain industrially. It is the temporarily easy course of cutting down expenditures for tools in order to have more things to consume right away.

The President's Council of Economic Advisers tells us we are spending too large a part of our national income on new tools and equipment. A larger share, they say, should go for goods and services used directly by consumers.

Before we take that advice, let us look at Britain. When the British once allowed their industrial plants and equipment to run down – they started down a dreary road to industrial stagnation and decay.

British industry once ruled the world. Low production costs enabled it to undersell all competitors. Efficiency gave British workers the highest living standards anywhere.

Now all that Britain has between it and economic disaster is pluck and American aid through the Marshall Plan.

The British people are living poorly – still on rations and in austerity. With practically everyone working, and working longer hours than we do in the United States, they cannot produce enough to pay for the raw materials and food they must import.

How did Britain get in this fix?

The story is complicated. British sacrifices in two wars play a tragic part in it. But another fact also stands out:

Britain began to go downhill even before World War I – when British industries allowed their plants and equipment to grow obsolete.

Once that process started, it grew steadily worse. By 1929 the share of Britain's national income being plowed back into capital investment had shrunk to less than two-thirds of what it had been twenty years earlier. We were putting twice as big a share of our national income into capital goods at this same time.

Skimping on capital equipment – on new plants and new tools – put the skids under industrial Britain.

World War II only speeded up a process already well under way.

continued on next page

British industry today shows the results of its failure to keep up to date. Here are three examples found by Dr. Laci Rostas, Britain's leading authority on measuring workers' productivity:

An American produces *four* times as much pig iron as his British counterpart.

He produces *more than four times* as many tires.

In all industry, on the average, an American produces almost three times as much.

The real reason is the American's better tools. The British are struggling with equipment that is, on the average, forty years old.

Britain once had a big head start in industrial equipment. But she let it slip away. And as it went, Britain's industrial and political leadership slipped with it.

How could British leaders have slept while all this happened?

This, too, is a complicated story. But parts of it stand out clearly:

1. *British business men put in more time perfecting cartels to avoid competition than they did in improving their plants and equipment to meet it.*

2. *British labor leaders concentrated on sharing the work and sharing the wealth—rather than doing the job necessary to have enough wealth to make the sharing worthwhile.*

3. *British governments taxed away the means to buy new equipment. By steadily increasing personal taxes, they undercut the* ability *of individuals to invest in new equipment. Finally, they took away the* incentive *to get new equipment by progressively taxing away any returns on it.*

4. *Farseeing socialists smiled all the while, knowing that as private industry more and more lacked the tools to do a progressive job, they would have their chance to run the country.*

Now, with Britain's fate in their hands, the socialists are trying desperately to stem the nation's economic decline by rebuilding its industrial plants and equipment.

They are making a little headway, but not enough. There are several reasons. One is that Britain must export most of the new equipment she can make. *Another major reason—increasingly important for her future—is that money needed to renovate Britain's run-down industry is taxed away to support welfare programs.* The (London) *Economist* grimly puts it this way:

"The importance of the function of saving has only been discovered now that the means of saving have largely been destroyed."

Our own Federal and State governments, too, have dangerously whittled away incentives. They have more than tripled tax rates on personal and corporation incomes in the last twenty years. Now, the President proposes to do more whittling.

If the United States is not to go Britain's way, we must preserve our incentives to save and to invest in industry.

If the United States is to progress, we must continue to build up our industries.

The President's Economic Advisers say we can slow down. But the McGraw-Hill survey of "Business' Needs for New Plants and Equipment," reported in the previous editorial in this series, produced facts to the contrary. It showed that industry *now* plans—*if it can get the money*—to spend $55 billion in the next five years for new plants and new tools. Moreover, it showed *industry's needs* for new facilities are large.

By cutting down the incentives to save, by giving soothing advice that we do not need to save so much, Washington is pushing us toward Britain's way—the route via industrial stagnation to socialization.

Before we skid too far, we should pull up short and ask ourselves: Do we want to go Britain's socialistic way?

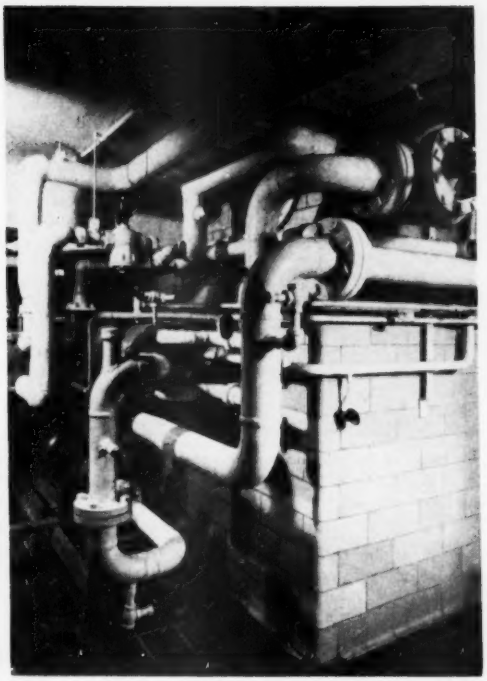
There still is time to say, "No."

A complete report on our national survey, "Business' Needs for New Plants and Equipment," may be obtained by writing McGraw-Hill Publishing Co., 330 West 42nd St., New York 18, N. Y. This is the fifth editorial of a special series on industry's needs for new plants and equipment.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

1 Single-thickness glass makes up much of the area facing north, south and west, and solar radiation affects design



2 Restaurant on street floor requires auxiliary refrigeration system; condensing-water piping for it shows above

Build for Sunlight and Zone Comfort

Large single-thickness glass areas give bright, sunlit interiors, but they create air-conditioning design problems. To meet them, Universal Pictures' new office building uses zones.

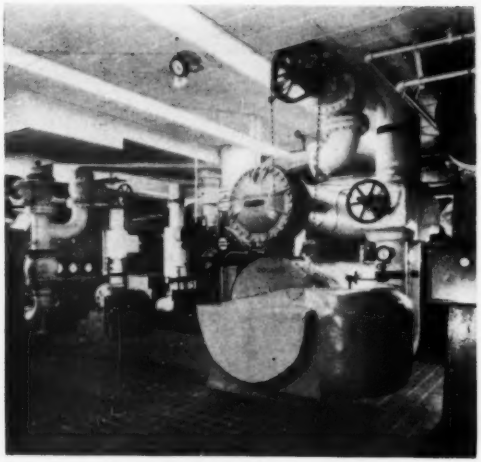
► UNIVERSAL PICTURES' office building constructed and owned by Tishman Realty & Construction Co in New York City, Fig. 1, has its 22 stories fully conditioned with temperature- and humidity-controlled air. A separate fan room for each floor has equipment: (1) graduated in size for individual floor load (2) spaced to permit shop fabrication of piping to operate for year-round requirements thus: for summer loading, from central-station refrigeration, and for winter heating, from a split-steam system.

The building has single-thickness glass facing on three sides—south, west and north. A typical floor plan has private offices arranged around the outer edges of the building and a large loft area in the center. Back of the building, or eastern area, holds elevators, fan rooms, stairways.

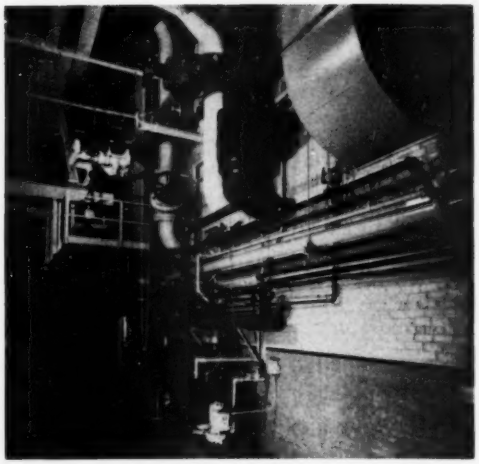
Solar radiation from such a large glass area figures heavily in designing for winter and summer loads. For instance, the presence of such a large expanse of single glazing made (1) zoned distribution of conditioned air necessary (2) humidification of air in winter months impracticable. Condensation on window surfaces with humidification would be objectionable. The effects this glass had on distribution and zoning will be discussed later on.

Year-Round Load. In planning for the building load the designers, Jaros, Baum and Bolles, and builders, Tishman Realty & Construction Co, selected a full air-conditioning system for the warm season and a split steam one for the colder heating season. This split system employs (1) a differential steam feed for overcoming heat losses attributable to radiation (2) a supply of ventilating, heated air for infiltration.

The same air ducts are used the year round. In addition, the building has these features: (1) Air at enough pres-



3 Heart of building air-conditioning system consists of two 500-ton refrigerating compressor units like the one above



4 Chilled- and condensing-water mains and some duct work come out from wall of main refrigerating room in Fig. 3, left

sure holds the building interior at a positive pressure compared to the atmosphere. (2) Steady change of air supplies fresh air in amounts never less than one third the total in circulation. (3) Zoned distribution of conditioned air operates both winter and summer.

Air Conditioning. Two 500-ton steam-turbine-driven centrifugal refrigeration compressors, Fig. 3, are the heart of the air-conditioning system. Direct coupling of these units to turbines permits a variable speed for capacity control.

Cooling medium for conditioning building air is chilled water passing through finned coils. Circulating-water pumps take it through a chilled water cooler and then through a riser main to the finned coils in the individual air-conditioning units, Fig. 6, in the fan room on each floor. The finned coils do two things to the air passing through. They both cool and dehumidify it.

A redwood-filled induced-draft cooling tower mounted on the roof cools water returning from the refrigeration and turbine condensers. There, returning water sprays over the fill in direct contact with a counterflow stream of air pulled from the base by induced-draft fan action. Water collects in the basin of the tower before entering the condenser cycle again. This collecting basin serves as a point for (1) chemical water treatment (2) addition of makeup.

Five circulating-water pumps in the refrigeration room work as follows: Two serve the chilled-water cycle and two the condensing-water one. The fifth acts as a standby. Its piping and valve setup has been arranged to permit throwing it into either cycle, Fig. 5.

During the winter heating season, low-pressure steam purchased from the New York Steam Corp is delivered to a steam riser from a pressure-reducing valve station. This steam riser reaches all floors and supplies steam to heating coils in fan units and duct work.

This duct serves three main zones and two interior ones. There is one zone each for the south, west and north areas of the building.

Fresh-Air Supply. Air entering the building passes through self-cleaning automatic filters. It is made up of recirculated building air, plus outside fresh air. When the supply fan and combination return-and-exhaust fan operate at minimum fresh-air setting, all fresh air goes to the intake of the air-conditioning unit.

This fresh air coming from the outside amounts to one third the total supply for the building. The combination return-and-exhaust fan at this minimum setting discharges all recirculating air back to the supply unit.

Under maximum fresh-air operating conditions the supply unit takes in 100% fresh air. The combination return-and-exhaust fan discharges all returning building air into a spill shaft running the full height of the building. Any intermediate setting depends on outdoor conditions.

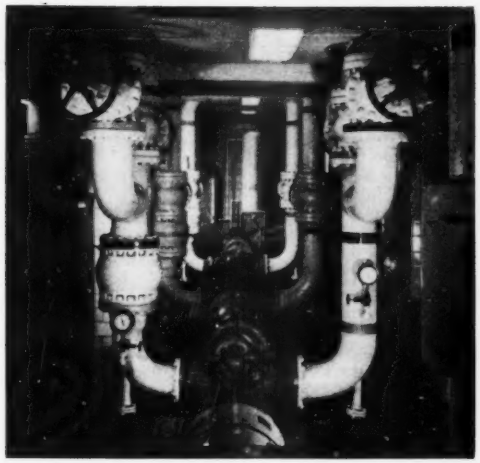
Once air leaves the supply unit it enters a plenum chamber for distribution to the various zones. Its pressure is sufficient to maintain a positive pressure within the building. Manual dampers plus automatic louver dampers control air entrance to all zones. In addition, each outside zone has reheat coils. The combination—special damper and reheat equipment in each zone—gives temperature control by a change in volume or heat, or both.

A minimum stop position on the damper control insures ventilation if for any reason the damper reaches this stop po-sition. In other words, air flow through ducts cannot be completely cut off by zone damper action alone.

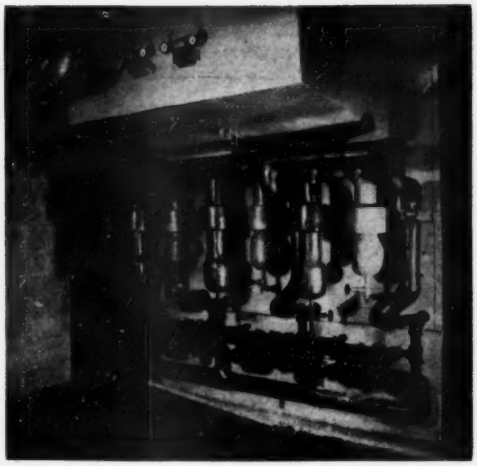
The activating impulse for temperature control for each zone comes from a thermostat, which is set in a typical section of the zone. That selected point reflects average zone conditions so all areas are at comfort level.

All thermostats have sliding-scale resets that tie with the outside temperature. When the outdoors experiences 70 F or below, inside temperature sets at a 70-F minimum. When temperature outdoors rises above 70 F the sliding scale takes effect. For each 2½-deg rise outdoors, the indoor minimum setting on each and every thermostat goes up one degree. For instance, at the summer design temperature of 95 F outdoors, the indoor temperature can go no lower than 80 F. This tie with the outdoors avoids any possibilities of "shock experience" between indoor and outdoor conditions.

Over and above the zone thermostats is a main thermostat, plus a humidity control in the fan room, which controls heating and cooling within the fan unit proper. This arrangement adds to the



5 Battery of pumps for chilled and condensing water in main refrigerating room. Spare unit, foreground, handles either



6 Air-conditioning units, graduated in size for individual floor loads, have their own heating and cooling coils

fineness of the zone controls since it sets the base requirements of the initial air supply. Both the main thermostat and humidity control operate to maintain a preselected set of conditions for the fan room similar to that described for zone thermostats above.

Western Zone. The western zone has still one more feature. It possesses a subcooling control by means of an added aftercooling coil. This extra step in conditioning air for this zone is made necessary because of the amount of solar radiation in the west zone.

The western face of the building receives the sun's rays at a more direct angle than, for instance, the south zone. Less of the solar heat is reflected and more passes through the glass.

This resolves into a wide variation in total sensible heat load between times the west zone is shaded or sunlit. To avoid a heavy modification of air volume through damper action a subcooling has been added. As a result of this subcooling, conditioned air at a lower temperature blows into the room during the period of extreme sun load.

Limited head-room conditions make it necessary to use: (1) the corridors as the return path for the major portion of return air (2) a sparing amount of actual return ductwork. Grille doors at each office and a large grille in the fan-room wall open to the corridor. An exhaust or recirculation fan within the room pulls air from the corridors for recirculation or discharge to the spillway depending on the system load.

Each and every fan room was designed in advance to permit as much factory-assembled equipment and piping as possible. One standard piping arrangement was used throughout the building. Equipment was graduated in size from floor to floor. That is, the equipment elements drop 30% in capacity ratings from top size to smallest.

The New York Steam Corp meets the equipment needs for steam. Except that portion for heavy service, like the main compressor turbine drives, all steam passes through reducing valves. Supply lines deliver steam at reduced pressure for winter use in the coils built into the fan units and ducts to give a split-steam system for heating.

PRINCIPAL AIR-CONDITIONING EQUIPMENT

Universal Pictures Building, New York, N. Y.

AIR CONDITIONING:

Air units, 23 ..... Buffalo Forge Co
Double centrifugal-fan sections, heating and cooling coils

Air filters, 23 ..... American Air Filter Co
Multi-duty, self-cleaning, time-clock control and oil bath

Temperature control, 23 ..... Johnson Service Co
Complete systems for year-round control

Diffusers ..... Anemostat Corp / Air Devices Inc

Cooling tower, 1 ..... J F Pritchard Co
Induced draft, steel and brick, copper lined, redwood fill

REFRIGERATION AND CHILLED WATER:

Compressors, 2 ..... Carrier Corp
Two stage, centrifugal, 500-ton capacity; shell-and-tube watercooler—1200 gpm from 55 to 45 F; shell-and-tube refrigerant condenser—107-F condensing temp

Turbines, 2 ..... Terry Turbine Co
Multistage, 528 hp, 125-psi supply steam

Condensers, 2 ..... Graham Co
Surface type, condenses 7700 lb per hr of steam

Pumps, 2, chilled-water service ..... Ketcham Pump Co
Centrifugal units, 1200 gpm against a 150-ft head; direct-connected to 60 hp, 208 v, General Electric motors

Pumps, 2, condensing-water service ..... Ketcham Pump Co
Centrifugal units, 1750 gpm against a 120-ft head; direct-connected to 75 hp, 208-v General Electric motors

Pumps, 1, standby service ..... Ketcham Pump Co
Centrifugal, 1750 gpm against 120-ft head, motor-driven

CONSULTING AND CONTRACTING FIRMS:

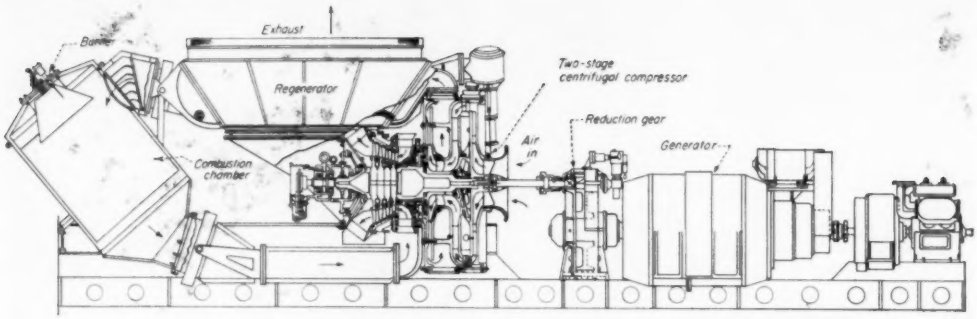
Consulting engineers ..... Jaros, Baum & Bolles

Architect ..... Kahn & Jacobs

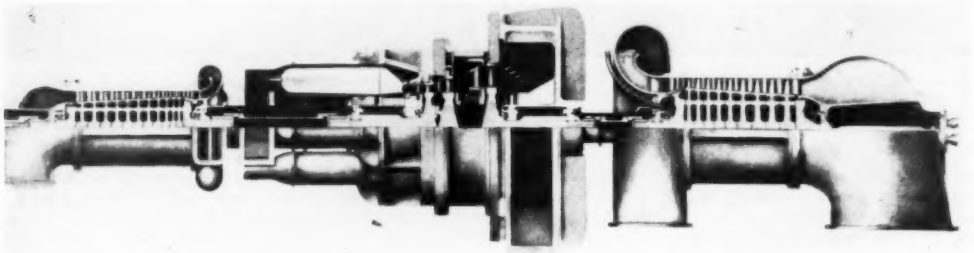
Contractor, air conditioning ..... Kerby Saunders, Inc

Contractor, insulation ..... Richmond Asbestos Co

Contractor, electrical ..... T Frederick Jackson Co

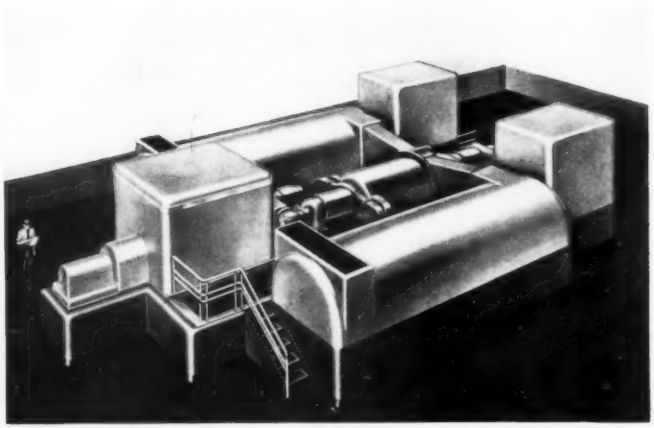


1 Elliott regenerative-cycle 3900-hp locomotive gas-turbine plant features two-stage centrifugal compressor. Unit designed to operate at 1275-F turbine-inlet temperature, pressure ratio of 3.5:1, over-all thermal efficiency of 24.9%



2 Rotating elements of General Electric's 5000-kw gas-turbine plant feature a split-turbine design. Two-stage h-p turbine drives a-p compressor and generator, single-stage l-p turbine drives l-p compressor; no reheating between turbines

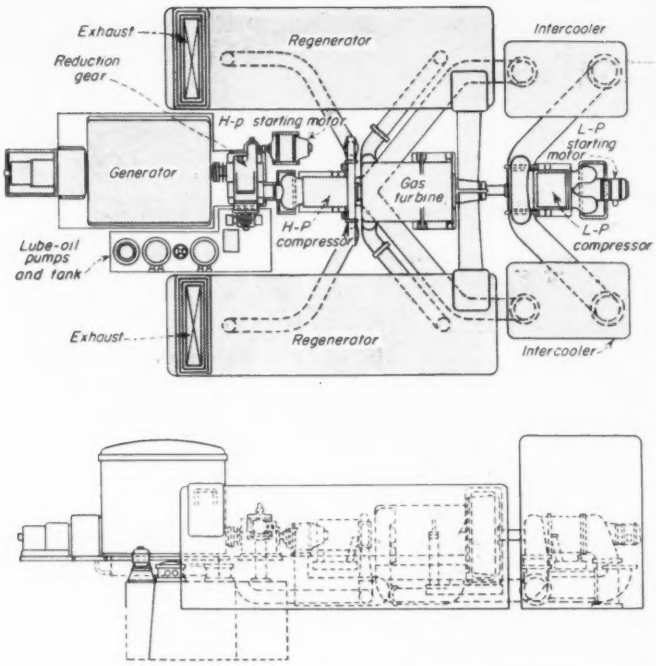
Commercial American Gas Turbines



4 Elements of GE's 5000-kw gas-turbine plant above can be identified by referring to Fig. 3. Regenerator exhaust openings will be connected to ducts to discharge exhaust outdoors. Inlet duct to low-pressure compressor can be arranged along floor or overhead. Plant designed to operate with 1500-F turbine-inlet temperature, 9:1 pressure ratio at over-all thermal efficiency of 28% (based on lhv)

Manufacturers reveal designs both under construction and planned for locomotive, stationary-power applications

► GAS TURBINES are on the threshold of commercial maturity. Having largely proved themselves in many respects in the laboratory they are being readied to work in the field (1) in central stations (2) driving compressors on gas pipelines (3) as propulsion units for locomotives and ships. In a series of papers presented before meetings of the American Society of Mechanical Engineers, American Institute of Electrical Engineers and the Society of Automotive Engineers, manufacturers have revealed designs of their latest units. Some are under construction, some have been put through laboratory



3 GE's 5000-kw high-efficiency gas turbine splits intercooler and regenerator into two elements each, connected in parallel. Entire plant located on one level

Begin to Take Shape

tests, and some are now being projected.

Six units have been sold by General Electric Co for installation in central-station service. Westinghouse Electric Co's 2000-hp unit (POWER, Jan 1947, pp 98-9, 102, and March 1948, pp 80-2) will be put to work on a gas pipeline, and similar units are being built for locomotive drive. Elliott Co has under construction three 3000-hp marine plants and two locomotive units, one shown in Fig. 1. Allis-Chalmers Manufacturing Co is building a locomotive unit and has several designs prepared for stationary power units, Fig. 5 and 6. DeLaval Steam Turbine Co has under construction a simple-cycle unit with a split-turbine design, Fig. 7. Foreshadowing an invasion of the small-capacity field, the Boeing Airplane Co is testing a 200-hp high-speed gas turbine, Fig. 8, 9 and 10.

General Electric Co. Three 3500-kw simple-cycle units for operation at 1450 F have been sold. One installation for the Oklahoma Gas and Electric Co has been described in POWER, Sept 1948, pp 64-71. This unit will burn natural gas. Two similar units have been ordered for oil burning, one by the Central Maine Power Co and the other by a New England utility system.

Two 5000-kw high-efficiency units under construction have been ordered by the Public Service Co of Oklahoma for natural-gas burning and another similar unit by the Bangor Hydro-Electric Co. This unit design has been extensively described in ASME Paper No. 48-A-83, *A 5000-Kw Gas Turbine for Power Generation*, by Alan Howard and C J Walker, and in AIEE Paper No. 49-114, *Two Gas Turbines for Power Generation*, by Alan Howard.

This plant, Fig. 2, 3 and 4, will operate with 1500-F gas entering the h-p turbine at a pressure ratio of 9:1 to produce a kw at generator terminals for 12,900 Btu. Over-all thermal efficiency will be 26.4% based on fuel's higher heating value, and 28% based on lower heating value. Air enters the l-p compressor which is driven by the l-p turbine, then flow splits between two intercoolers in parallel before entering the h-p compressor on the h-p turbine shaft, which also drives the generator. From the h-p compressor, air again divides equally to flow through two regenerators in parallel prior to entering six combustors. Gas discharges directly into the two-stage high-pressure turbine. Exhaust from the h-p turbine immediately enters the single-stage l-p turbine. Both turbines are overhung from their bearings and run in a common casing. L-p turbine exhaust splits to enter the parallel regenerators from where it discharges to atmosphere.

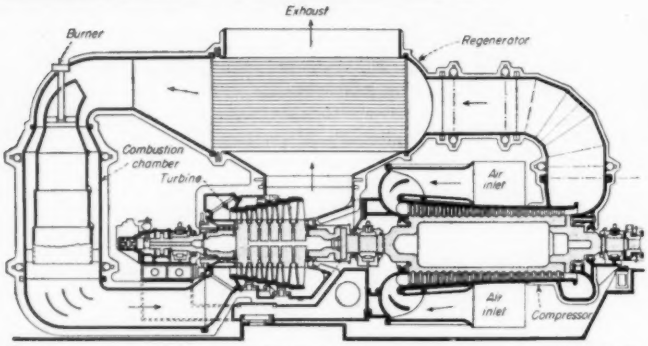
Innovations in component design include the use of movable guide vanes to control air flow into the first stages of the compressors. This improves part-load efficiency of the plant, in addition to the effect of the variable-speed l-p turbine and compressor.

A small amount of cooling air flows through drilled holes in the nozzle partitions, then does further cooling duty on the inside nozzle ring and the first-stage wheel rim. A total of 30 gpm of water cools the turbine stator by water passages in the circumferential rings and in the l-p turbine support struts. Stationary water pads cool the turbine wheels by radiation through the small intervening distance. The l-p turbine exhaust diffuser consists of an airfoil grid bent into a complete circle and supported in the turbine exhaust annulus. The grid gives a high degree of pressure recovery and turns the stream radially into the exhaust ducts.

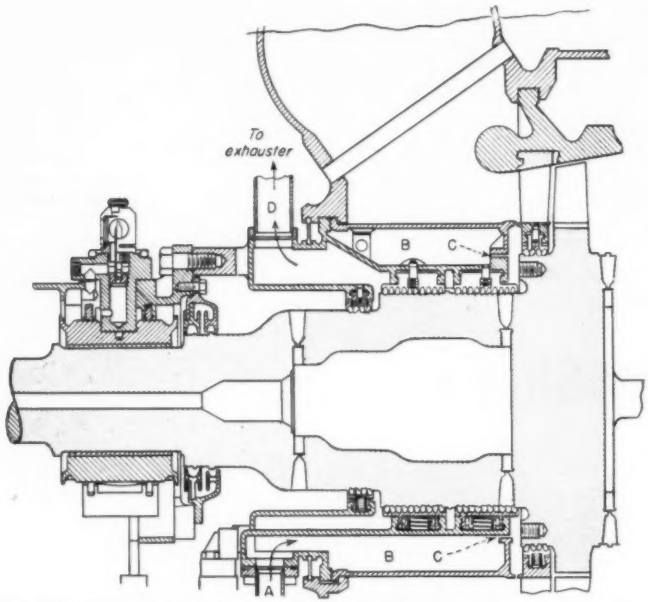
Elliott Co. The first marine plant (POWER, Aug 1945, pp 76-9) built by this group is being essentially duplicated for three additional units to operate at 1400 F with 5.75:1 pressure ratio for an over-all thermal efficiency of 33.4% when producing 3000 hp. These units together with a new locomotive unit, Fig. 1, were described in an AIEE conference paper, *Elliott Gas-Turbine Developments Applicable to Power Generation*, by E S Dennison.

The regenerative-cycle single-shaft unit, Fig. 1, features a 2-stage centrifugal compressor. Unit is rated at 3910 hp with 1275-F inlet temperature and 3.5:1 pressure ratio. Turbine and compressor speed will be 5910 rpm, expected thermal efficiency is 24.9%. Tubular regenerator will be designed for an effectiveness of about 50%. Oblique position of the single combustion chamber makes the fuel nozzles accessible. The 4-stage turbine has shrouded blades and exhausts into the underside of the regenerator.

Combining turbine and compressor



5 Allis-Chalmers' 7500-kw gas-turbine plant has regenerator, will use 1300-F turbine-inlet temperature, 4.7:1 pressure ratio. Thermal efficiency equals 22.2%



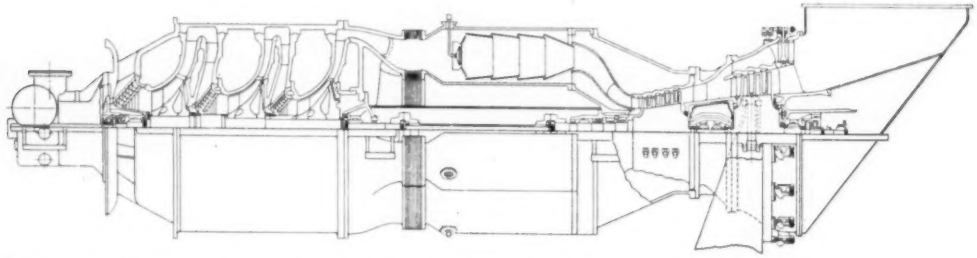
6 High-pressure turbine gland seal on Allis-Chalmers unit prevents gas leakage, cools turbine rotor at first stage, cools turbine shaft in adjacent bearing

rotors into a single assembly makes a compact unit. Turbine disks are welded to each other and to two stub shafts. The forward shaft extends to a bearing between the compressor impellers that supports them. Sealing and leakage problems are minimized by opposing the high-pressure ends of turbine and compressor.

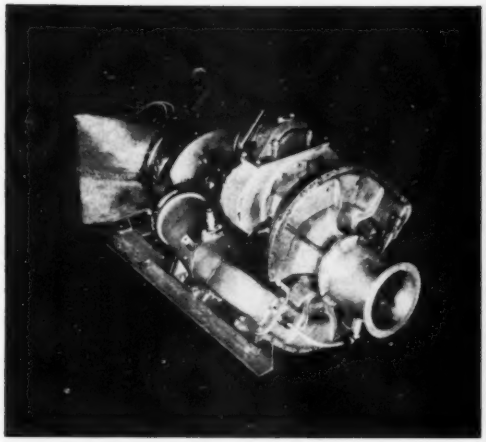
Tests of the 2-stage centrifugal compressor show an efficiency of 79.2% at the design point. This is an acceptable level of performance. In compound cycles the compressor offers opportunity of intercooling between each pair of stages, that is, after each compression through a ratio of 1.8 to 2.0:1. Repeated intercooling gives an over-all result rivaling that of the axial compressor, in spite of an inherently more efficient compression process in the axial. Low first cost of the centrifugal favors it over the axial.

The regenerator in Fig. 1 recovers 4000 Btu per hphr at rated load. Assuming a fuel cost of 20 cents per million Btu the regenerator saves 80 cents per 1000 hphr. Elliott experience indicates that a regenerator of the type used in the locomotive unit can be provided at a price not above $5 per hp. Hence after 6000-hr operation at rated load the regenerator pays for itself by fuel savings.

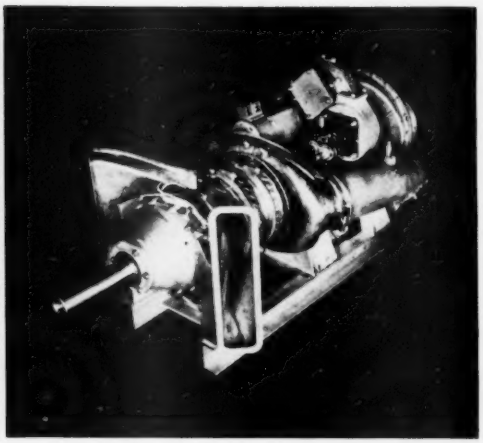
Allis-Chalmers Mfg Co. Fig. 5 shows a proposed regenerative single-shaft 7500-kw gas-turbine unit for stationary-power applications. The turbine is designed for 1300-F inlet temperature with a 5:1 pressure ratio. It is directly coupled to a 3600-rpm generator. For smaller units down to 2500 kw the same arrangement will be used and include a reducing gear connection to the generator. For units up to 15,000-kw capacity the same arrangement will also hold with the exception that two compressors and a double-flow turbine would be directly connected in line to a 3600-rpm generator. This unit was described in an AIEE conference paper, *A Design of Gas Turbine Suitable for Peak Load*



7 DeLaval's 3000-hp gas-turbine unit features 3-stage mixed-flow compressor, split-turbine design, bypass around l-p load-driving turbine. Unit built for 1300-F turbine inlet temperature, 6:1 pressure ratio, thermal efficiency of 17.6%



8 Boeing Airplane Co's experimental 200-hp gas-turbine unit as it appears from the compressor end; air inlet at right



9 Boeing's gas turbine as seen from turbine exhaust end. Note two combustion chambers and accessory case at right

and End-of-Transmission-Line Operation, by W B Tucker. Over-all thermal efficiency of the unit at full and part loads will be:

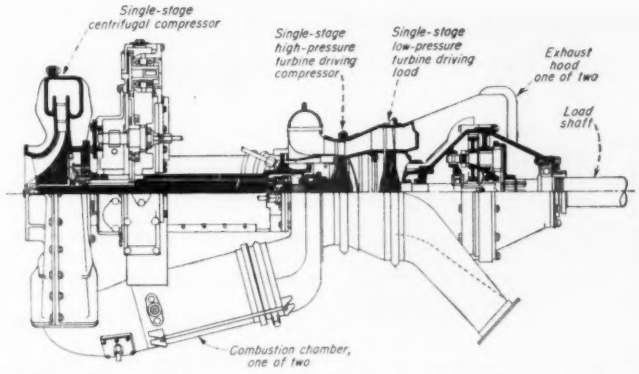
	Over-all thermal effy, %			
	Lower hv		*Higher hv*	
Load, kw	*Oil*	*Gas*	*Oil*	*Gas*
3750	15.2	15.0	14.0	13.5
5625	19.2	19.0	17.7	17.1
7500	22.2	21.9	20.5	19.8

The turbine spindle and compressor rotor are supported on three bearings with a stiff coupling between. The 6-stage reaction turbine will deliver a total of 24,000 kw at rated load.

Fig. 6 shows the gland seal arrangement at the h-p end of the turbine. The gland (1) prevents escape of the hot gas (2) cools the turbine spindle (3) reduces temperature of the shaft at the adjacent journal bearing.

Air from the compressor discharge enters at *A* to belt around gland, *B*. It then flows through circumferential opening *C*, part entering the turbine gas path at the entrance to the first moving row of blading by passing through the labyrinth under the first stationary row of blading. The remaining air flows through the labyrinth surrounding the turbine shaft and passes out at *D* to a small exhausting fan. The same arrangement is made for the l-p gland except that only enough h-p air is used to block flow of turbine exhaust through the seal.

DeLaval Steam Turbine Co. First details of a 3000-hp gas turbine unit, Fig. 7, were given in another AIEE Paper No. 49-113, *A 3000-Horsepower Gas Turbine Power Plant*, by J S Haverstick of this company. The unit, under construction, will operate with 1300-F turbine inlet at 6:1 pressure ratio. The plant features a 3-stage mixed-flow compressor delivering 44,500 cfm of air to the eight combustors. The split turbine is arranged so the h-p element drives the compressor and the l-p element the load.


Single-stage centrifugal compressor
Single-stage high-pressure turbine driving compressor
Single-stage low-pressure turbine driving load
Exhaust hood one of two
Load shaft
Combustion chamber, one of two

10 Half section and plan of Boeing unit featuring single-stage centrifugal compressor, two combustion chambers, two single-stage turbines, reducing gears

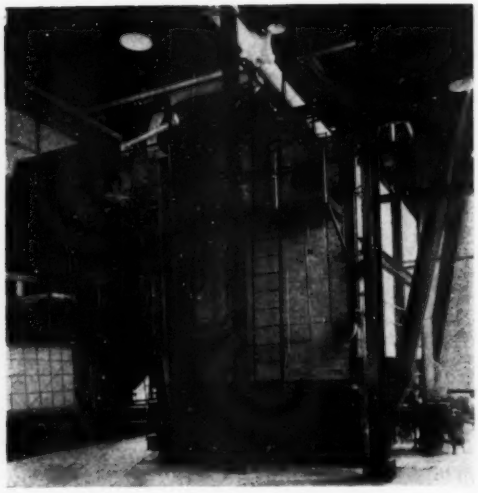
For operating flexibility, especially in transportation applications, a gas bypass is provided around the l-p driving turbine. The bypass is an annular passage surrounding the l-p turbine casing. Flow is controlled by a series of valves at the end of this passage, allowing the gas to flow directly into the turbine exhaust hood. The bypass would be used only during idling periods when no-load fuel consumption will be reduced by allowing a greater pressure drop across the h-p turbine. This turbine drives the auxiliaries in addition to the compressor and may be arranged to develop a small part of the net output.

The mixed-flow compressor works at high efficiency and its operating range in respect to pumping limits is midway between the centrifugal and axial.

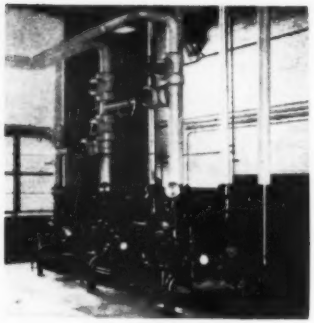
Boeing Airplane Co. In a paper presented before the Society of Automotive Engineers, *The Boeing 200-hp Gas Turbine*, by S D Hage, first details were given on an experimental unit that had undergone extensive tests last year,

(*Continued on page* 170)

1 Engine-ready tracks above dispatch 85 locomotives daily. These engines need help from power plant when "firing up"



2 Two 9000-lb-per-hr stoker-fired watertube boilers replace four hand-fired locomotive units as steam suppliers



5 Ample quantities for laundry, wash and fill come from the pumps above

Good Stationary-Power

Key points in any railway system are the terminals. Their biggest job is to have all power services on tap, says L W Sagle in describing B&O's facilities in Grafton

► RAILROAD TERMINALS are important key points in keeping rail traffic moving. And they lean heavily on their stationary power plants for the energy to carry off the job smoothly. Take, for instance, the modern power plant the Baltimore & Ohio Railroad recently completed at Grafton, W. Va.

Grafton terminal is the headquarters of the Monongah division serving one of the heavy mountainous regions of the B&O. For years this terminal depended on an old frame-construction power plant, which like Topsy "just growed." It housed four locomotive-type, manually fired boilers. Toward the end of its life the plant was badly overloaded and burned too much coal for the steam load it supplied. In addition the air compressors, pumps and feedwater heaters were of obsolete design and replacements parts could no longer be obtained.

Since power and the power services meet a major share of railroad terminal functions the B&O took steps in 1945 to build a modern power plant at Grafton. This new plant furnishes steam for (1) heating the various buildings and the passenger cars in the sidings; for emergency standby to the relief crane, and (2) for firing up locomotives, Fig. 1, in the roundhouse. As many as 85 locomotives leave this terminal daily. Compressed air and water for the various shops also come from this plant.

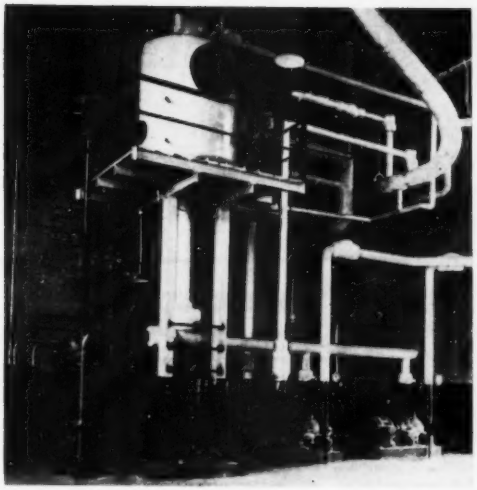
Two 9000-lb-per-hr watertube boilers comprise the steam-generating facilities. These units are fired with automatic stokers and handle coals available along the lines of the B&O.

Coal Handling. Coal comes in on railroad cars and is unloaded from a siding alongside the power plant. The coal dumps into a track hopper. This, in turn, opens into a flight feeder, which supplies a uniform flow to a coal crusher. If necessary, the coal can bypass the crusher, say, during a temporary emergency. In such a case it goes direct to elevator buckets to be hoisted into a bunker on top of the power-plant building. From the bunker, coal flows by gravity through gates and chutes to the stoker hoppers.

The normal routing for the coal is through the 18x18 in. single-roll coal crusher. This crusher can reduce coal up to a top size of 8-in.-dia lump down to 1¼-in. size at the rate of 25 tons per hr. A fully enclosed dustproof 15-hp fan-cooled squirrel-cage motor drives the crusher through a series of V-belts.

From the crusher the coal follows the path outlined above—by elevator bucket, of the centrifugal discharge type, to a 12-in. chute at the top of the building. This chute, set at a slope of 45 deg from the head of the elevator, directs coal into the center of the 16-ft-high 19-ft-dia 150-ton coal bunker. From this distribution point coal reaches the individual stoker hoppers by gravity feed.

Ash from the underfeed stokers is collected first in ashpits and is then



3 Deaerating feedwater heater acts as collection point for makeup and condensate. Boiler feed pumps draw from it

4 Compressed air performs a number of services throughout shops. Units above, one steam, one electric, meet demand

Facilities Keep Railroads Moving

pulled onto ash intakes. A vacuum-suction system connects to these intakes, which are spotted near the ash-pits. This suction pulls the ash fed to the intakes out through an 8-in. pipe, which makes up the ash-conveyor system. The strong air-and-ash stream, which the vacuum produces in this conveyor system, is directed to a target box. Here ash falls out of the transporting stream into a storage bin. The air passes out through a washer vent, which removes entrained dirt to give a commercially clean air discharge.

Water System. A 60,000-lb-per-hr deaerating feedwater heater acts as the collection point for (1) any returned condensate from the various steam users (2) any makeup water necessary. Two 200-gpm boiler feed pumps can draw water from this heater. One pump is motor driven, while the other is turbine driven.

There are pumps to supply locomotive laundry water and wash-and-fill. The laundry pump delivers 250 gpm, and the two wash-and-fill pumps are of 300-gpm capacity.

Over and above this equipment are two air compressors, one steam driven, with a capacity of 785 cfm, and the other motor driven, with a capacity of 895 cfm.

The 150-ft brick chimney dominates the little valley. It has a 24-ft-wide base and a 7 ft-6-in. internal dia at the top. A set of lightning conductors mounted according to the Kellogg system protect the chimney against lightning bolts.

The power plant itself is a square building, 113 ft 3 in. by 113 ft 3 in., of brick construction on pile and concrete foundation. It has large glass-block windows taking up the major share of three of the building's sides. The result is a well-lighted interior.

Total costs for building and track changes, completed in 1946, ran $102,130. Equipment costs were an additional $100,870. But this investment indicates savings from (1) reduced coal consumption (2) decreased machinery maintenance (3) adequate air and steam supplies.

Principal Power-Plant Equipment

Grafton, West Virginia Power Plant, Baltimore & Ohio Railroad

STEAM GENERATION AND AUXILIARIES:

Boilers, 2	Babcock & Wilcox Co
9000 lb-per-hr, watertube, stoker-fired	
Stokers, 1 per boiler, underfeed	Westinghouse Elec Corp
Ash-removal steam-exhauster system	Brady Conveyor Corp
Coal-handling conveyor system	Beaumont Birch Co
Crusher coal, 1	General Electric Co
Single roll, 18x18 in., 25 tons per hr, motor drive	

PUMPS AND WATER EQUIPMENT:

Pumps, laundry, one, 250 gpm	Ingersoll-Rand Co
Pumps, wash and fill, two, 300 gpm	Ingersoll-Rand Co
Boiler feed pumps, 2,200 gpm	Ingersoll-Rand Co
1, motor-driven; 1, turbine-driven	
Deaerator, 60,000 lb per hr, deaerating	Worthington P & M Co

MISCELLANEOUS EQUIPMENT:

Compressors, 2	Ingersoll-Rand Co
1 steam-driven, 785 cfm; 1 motor-driven, 895 dcfm	
Chimney, 1, brick, 150 ft high, 7 ft 6 in. dia at top	local construction
Conductors, lightning-chimney mounted	Kellogg Co

Practical Pointers on

By L N ROWLEY, *Executive Editor*, and J C McCABE, *Associate Editor*

UNDERFEED STOKERS

(See May 1948, pp 84-87)

CHAIN, TRAVELING GRATES

(See March 1948, pp 88-91)

GENERAL

Know your fuels
Know your equipment
Be sure fuel and equipment match
Know the three "T's"—Time, Temperature, Turbulence

Furnace volume should be ample for conservative heat release; setting height must be related to flame travel.

Stoker area should be adequate to carry maximum load at a reasonable burning rate (depends on stoker type, whether or not furnace is watercooled, etc).

Watercooling in furnace or in stoker itself may reduce clinkering difficulties and hence extend range of coals.

Furnace must provide positive mixing of rich and lean gas coming off fuel bed, either by arches, overfire jets, or both.

Older arch furnaces may have inadequate volume, and be sensitive to fuel change.

Positive means for controlling air flow to various grate zones must be provided in stoker design and maintained in good working order.

FUELS

Use the fuel your equipment was built to burn
Give your fuel every break; keep it clean, store it and handle it the way your supplier recommends
Fuel selection is an art; learn it thoroughly

Single-retort underfeeds handle most bituminous coals, and anthracite. Preferred choice limits top size to from ¾ to 2 in.

Usual specifications call for 2-in. nut and slack with no more than 50% through a ¼ in. round-hole screen.

Multiple-retort units handle a range of bituminous coals. Top size runs about 2 in. Best results are usually had with caking coals having a relatively high ash-fusion temperature.

Caking qualities of coal should be suited to amount of agitation stoker gives.

These units work best on free-burning coals; prove suited for anthracite and coke breeze.

Ash content should be above about 6% to insure protection of rear grate section.

With natural draft (0.1 to 0.15 in.) coal having top size of 1¼ in. and little fines below ½ in. gives good results. Heavier draft permits coals of 1½ in. top size, having range of fines naturally occuring in crushing.

Forced-draft grates can handle higher percentages of fines, smaller top size.

OPERATION AND MAINTENANCE

Make sure operators know their job and the equipment.
Recognize the load limits your equipment can carry. Don't make it carry overloads.
Make sure air supply is in proper relation to fuel feed and that it is distributed correctly.
Mixing of fuel and air is important. Be sure it is thorough.
Hold drafts to recommended level for equipment, fuel.
Remember fuel-burning equipment is largely mechanical. It needs regularly scheduled maintenance to operate as the designer intended. Set up a preventive-maintenance program.

Avoid overloads and attendant high burning rates. A change to a higher-quality coal may reduce effect of overload.

Keep fire out of retorts. If burning in retorts occurs, look for too-thin a fuel bed, an empty hopper or improper banking.

Make sure fuel feeds uniformly over the grate. Change position of secondary rams or pushers until uniformity is obtained.

See that grate-bar ends are always covered. Don't remove ash or clinker that stays on grate bars after dumping. Let normal stoker operation bring it down.

Learn proper fuel-bed thickness for your particular coal. It runs about 5 to 7 in. for single retorts; 14 to 18 for multiple.

If fuel bed is too heavy fire becomes uneven, air distribution falls down, holes develop, smoke forms. Too light a bed may produce retort troubles.

Don't work the fire more than is needed. Even the fuel bed out by lightly raking the surface. Forget the slice bar.

Hold overfire draft to about 0.1 in. A rule of thumb for underfire draft calls for 0.1 in. for each 10 lb of coal burned per sq ft per hr.

Always keep a flow of air through grates except when on bank.

Maintain a clean fire and clean ashpit.

Maintain an even fuel bed. Rate of ignition controls grate speed and fuel-bed thickness.

Air flow directly affects ignition. Be constantly on guard against air leaks into the furnace. Such leaks break down pressure difference across fuel bed, lower the ignition rate.

Natural-draft grates have about 20% air space. Below 0.1 in. draft overheating of grates may be encountered. Too high a draft (over 0.5 in.) causes excessive gas velocities, cinder carryover. Usual range is 0.1 to 0.15 in.

Forced-draft units have 7 to 10% air space in the grate. Draft loss across the fuel bed runs about 1.5 to 2 in.

Stoker design provides for regulating air flow to different zones of the grate. For best results, air distribution must be adjusted carefully and maintained at correct flows.

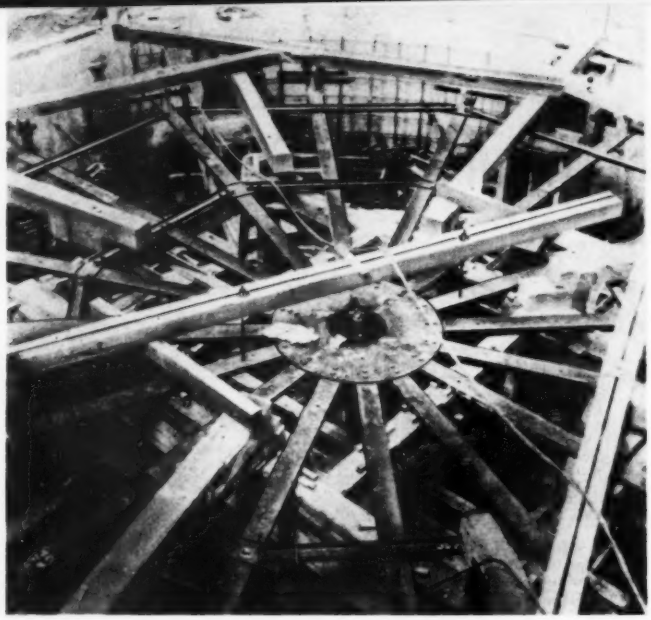
Keep ashpit and under-grate areas free of siftings. Neglect can cause warping of grate surfaces and windbox sections with consequent loss of control of the air flow.

Make sure mixing is thorough. If not adequate, install overfire jets.

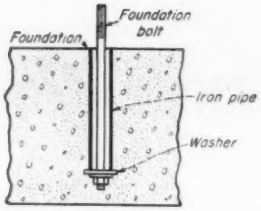
Smoke Prevention in Your Boiler Plant

Here, in summary form, are the highlights of *Power's* series on atmospheric pollution. It all adds up to: (1) correctly matched equipment and fuel, plus (2) sound operating methods

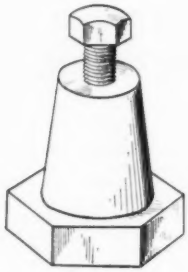
SPREADER STOKERS	PULVERIZED COAL	OIL AND GAS
(See March 1948, pp 88-91)	*(See Jan 1948, pp 76-79)*	*(See Sept 1947, pp 64-68)*
Provide ample furnace volume and setting height to insure smoke-free operation. Turbulence is essential to good mixing over the fuel bed; install overfire jets if needed to avoid stratification Cinder collection and reinjection are often desirable to reduce dust emission and to keep down carbon loss to stack. Automatic control pays dividends.	Be sure pulverizer capacity is adequate to deliver fuel of desired fineness at all loads with usual moisture content. Furnace must provide for full flame travel and have proper balance between uncooled and cooled surface to insure good ignition. High degree of turbulence is necessary for controlling "tail" of combustion.	Match combustion chamber shape and length to flame shape and length. Make sure that flame does not impinge on furnace walls or boiler surfaces. Such impingement increases maintenance and often causes smoke. Burner installation should be able to handle desired load range. This may mean wide-range burners or multiple burners.
Spreaders do best on coals under about 1¼ in. with preferred size of the order of ¾ x 0 in. nut and slack. Coarse coal tends to wear the feeders and may cause clinker. Watch size consist of coal; lack of uniformity should be avoided. Avoid segregation by maintaining hopper half full at all times and by using non-segregating chutes, mechanically operated spouts or traveling larries. Spreaders handle a wide range of coals from lignite through the various types of bituminous, but not 100% anthracite.	Small mills do best on coals up to about ¾ in. top size. For medium and large mills, best top size runs about 1 to 1¼ in., respectively. For any specific mill maker's specs should govern. Fineness of pulverization depends on grindability, ash content, moisture, etc. These may also affect mill capacity. In selecting coals, bear these factors in mind, remembering also that desired fineness is influenced by such factors as volatile content, etc.	Commercial oils and gases offer little in the way of selection problems. It is, however, essential that burner characteristics be suited to the nature of the fuel burned. Fuel must be supplied under pressure and temperature conditions the burner expects. Make sure that the fuel-handling system, from pipeline or storage tank right up to the burners, is designed to deliver clean fuel. Be careful in mixing fuel oil from different sources; some mixtures promote sludging
Too high a percentage of fines may put too much of coal in suspension for furnace volume and available combustion time, cause excessive dust emission. Keep a thin, level fuel bed; a heavy one clinkers and smokes. Both under- and over-fire draft should be held relatively low, at values consistent with a slight negative furnace pressure. Low windbox pressure, with relatively high grate resistance, avoids heavy fluctuations as fuel-bed thickness changes, also excessive cinder carryover and, in extreme cases, blowholes. Holding overfire draft low avoids high gas velocities. It's a good idea to restrict fuel feed to about a minute's supply. Remember that rate of ignition drops on low-load operation and smoking can develop as a result. Clean fire pits and ashpits at regular intervals. Siftings in ashpits, once ignited, can damage grates, cause loss of air control. Set up the correct banking procedure and follow it. Check damper positions, baffle condition and furnace walls periodically.	As far as possible operate pulverizers near best capacity level. Maintain air preheat at proper level, usually in the neighborhood of 500 F. Take periodic samples of mill output to keep to desired fineness. Check pulverizers regularly for wear; make required adjustments to maintain desired fineness. Put in orifices or directional vanes if feed distribution is not uniform. Vibrators in raw-coal feed to pulverizer keep wet coal moving, avoid "hangups." Check all damper and vane settings in air supply lines periodically. Hold primary air as close as possible to best ignition-air ratio for all loads. Be sure burners are adjusted to provide right flame shape, air distribution, ignition point within the furnace. Watch percentage of excess air in relation to ash content of fuel. As ash content increases, percentage of excess air must be increased to hold combustible loss at a fixed level. Eventually it becomes a question of balancing loss in combustibles (most of which go up the stack) against dry-gas loss. Make sure that dust collectors operate at design conditions; do an effective job.	Watch burners for wear caused by abrasion of ash in fuel and for carbon buildup. Always protect cup of a rotary burner after it is turned off, otherwise carbon forms in the rim and spoils atomization Worn or carbonized mechanical-atomizing nozzles play hob with good combustion; replace worn nozzles and keep them clean. Many smoke troubles arise from faulty air supply. If installation is manually controlled, make sure air supply is regulated when oil flow is changed. Keep air inlet and fan blades clean. Clogging dirt and lint cut air flow; smoke may result. Smoke may be produced when starting a cold furnace. If preheating steam is not available, use light oil until furnace is hot and preheating can be done. Always start with a moderate flame, shifting to high when furnace has warmed up. Watch out for formation of "carbon mushrooms" on walls of a cold furnace. Avoid overloads. If multiple burners are installed to vary load, be sure any burner taken out of service is removed from furnace to avoid carbon buildup. Watch out for "dribbling" when burners are shut down; if burner dribbles, check the valves.



1 When the foundation bolts must be located and held in place accurately, make a template of structural-steel shapes, assembled with body-bound bolts and dowels



2 Clearance around foundation bolts gives small amount of side movement



3 Low-cost cast-iron screw jacks level and support machines on foundations

Give Your Machine a Break

If a power-generating machine's foundation is good, next problem is to align it accurately and anchor in place. N L Rea, an erecting engineer of long experience, tells how it's done

► A RIGID FOUNDATION and accurate alignment are musts if a machine is to operate satisfactorily. Of equal importance is the way the machine is leveled and anchored to its foundation. How these problems are handled varies with type and size of machine, as well as the experience and resourcefulness of the erector.

Building Foundations. It is impossible to give hard and fast rules or detailed instructions for building foundations because of local soil conditions, size of apparatus, building design and other factors. Have foundations designed by an experienced engineer, who keeps in mind that rails for small units and baseplates for all machines, either fabricated or cast, are designed to act as liners between machine parts and foundation only. Rails and bedplates are flexible and may get out of true from the relief of internal strains in machining or from handling in shipment or installation. They must not carry any weight unless properly supported on their foundation.

Foundations must, therefore, be strong and rigid, made of either reinforced concrete or steel girders, of sufficient weight and stiffness to insure freedom from vibration, and designed to support the baseplate evenly and to relieve it from strains or distortion.

Foundation Bolts. For large units whose foundations may be subjected to shocks and heavy stresses, locate foundation bolts accurately and hold them in position with a rigid template until concrete is poured around them. This requires careful, exact work because all foundation bolts must be held within clearance of the bolt holes in the baseplate, usually $\frac{1}{16}$-in. total. This procedure gives maximum strength to the foundation.

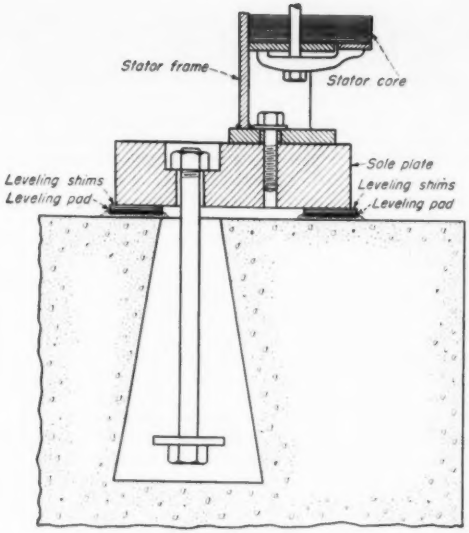
For small or medium-sized machines where foundations are relatively massive and stresses low, provision can be made for some sidewise movement of the foundation bolts, if installed as in Fig. 2.

Thread the foundation bolts on both ends and provide steel plates or washers, at least 4x4 in. for smaller units and larger in proportion for larger units. Put these plates on the bottom end of the bolts and screw the nuts on at least a full length. Tack weld the nuts to the bolts and to the plates or washers. This prevents the bolts turning in the nuts when tightening the top nuts during erection.

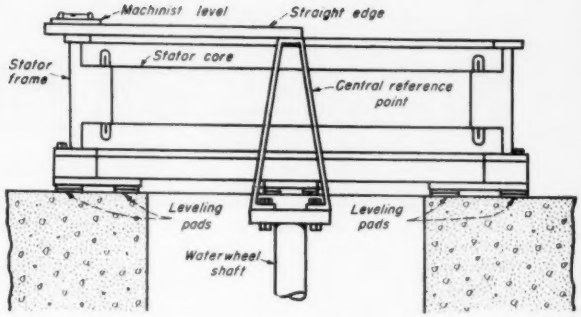
Slide down over the bolts ironpipe conduit or even sheet-iron stove pipe, an inch or two larger than the bolt. Have these clearance pipes long enough to extend above top of concrete. Center them on the bolts, and tack weld to the washer on bottom end, then block with wooden collars at top.

Hang these bolts with the assembled parts in a wooden template supported over the form, and fasten securely to prevent shifting when concrete is poured. Be careful to have more than enough thread on upper ends of bolts, and set them high enough to give plenty of thread above the base. You can easily cut off extra length above the base, but you can't stretch a bolt that is too low.

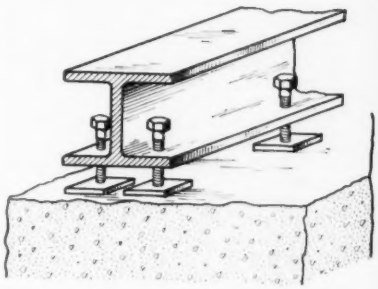
Foundation Pads. Many machines are equipped with sole plates or foundation pads instead of bases. This is



4 If foundation stresses are low enough, leave truncated pyramid pockets for foundation-bolt assemblies



5 As central point on vertical generators of waterwheels, bolt to its coupling face a support equal to distance to generator-frame top



6 Lower flanges of many structural-steel machine bases are drilled, tapped for jack screws

With a Foundation That's Good

standard practice for large vertical units. It would be difficult to set and grout these plates before assembling the stator sections on them.

When foundation stresses are low enough, it is good practice to leave pockets for foundation bolts and sole plates. Make these pockets in the form of a right-angled, truncated pyramid, Fig. 4, large enough at top to admit the assembled foundation bolt and plate or washer, also several inches larger at bottom and a few inches deeper than length of the foundation bolts.

Tack weld the nuts to the bolts and the plate to the head bolt's head or nut. Then assemble the foundation pads in approximate spacing and elevation with the assembled foundation bolts and washers hanging in their respective holes.

Bolt Stator to Pads. Drop the stator on the foundation pads and bolt them together, using circular shims or collars to put each holding-down bolt in the center of its hole in the stator flange. This clearance is usually $\frac{1}{8}$ in., so 1/16-in. sheet metal or fiber stock can be used for the collars.

Set the stator to elevation using the surface, which must be right as reference. This is usually the top of the frame, which carries the top bearing bracket or thrust deck and must, therefore, be set to elevation and be level. The stator must also be centered and made round, if it has been distorted in handling. Fig. 4 shows setup of the foundation plates and the foundation bolts and washers.

This arrangement gives maximum strength to the bond between the concrete and the stator's foundation bolts and foundation plates. There is $\frac{1}{8}$-in. clearance around the stator's holding-down bolts to permit final adjustment of the line-up and air gap.

Stator is then doweled to foundation plates, to give a solid metal-to-metal tie to the foundations. Holes in the foundation around the bolts can be partly filled with grout and the bolts tightened to hold stator securely in position during adjustment and leveling, and while grouting.

Collars are removed from around the holding-down bolts in the lower stator-frame flange, after foundation plates have been grouted. Thus maximum movement is given in all directions if it is necessary to shift the stator on the foundation plates to center it to the revolving field.

Space requirements and the heavy stresses in the foundations of large units may prohibit clearance holes around the foundation bolts. This makes it necessary to set the bolts accurately in the foundation forms and hold them securely when the foundation is poured.

Structural-Steel Template. If and when this is necessary make a template of structural-steel shapes. Assemble with body-bound bolts and dowels, and match-mark it so it may be knocked down for shipment or storage and reassembled over the foundation forms. This template must be stiff enough and accurately made to hold all the bolts to within 1/32 in. of exact location while the foundation concrete is poured. Fig. 1 shows a template used at Boulder and Shasta Dams. It cost about $500 but saved several times this amount as it was used for 12 generators.

Leveling machines on their foundations used to be done with tapered wedges forged by the nearest blacksmith. These proved inadequate as size and weight of machinery increased, because it was impossible to support the load evenly or to adjust the individual wedges with any certainty and hold them securely during the grouting. Results are better if you use the wedges in pairs and point them opposite each other so top and bottom surfaces are parallel with foundation and baseplate.

Leveling Jacks. Cost of wedges is now

prohibitive unless they are ordered in large lots from a drop-forge shop or are made of malleable iron or cast steel. Experience proves that wedges even when used in pairs are not so satisfactory or cheap as other methods. A paper-machine manufacturer arranges for hexagonal bearing pockets in the underside of his machines' base frames. He provides a cheap cast-steel jack, Fig. 3, to drop in these pockets when assembling and leveling the machine.

These jacks have a ¾- or 1-in. bolt with a round, hardened head so they can be adjusted easily. The jack's hexagonal base keeps its body from turning in its hole when the machine is leveled and aligned, and the foundation bolts tightened to hold every part securely when the grout is poured. The low cost of these little jacks is offset many times by the saving in labor. They also give a permanent solid-metal support to the machine.

Jackscrews in Flanges. Many structural-steel bases can be drilled and tapped for jackscrews in the lower flange, Fig. 6. These jack bolts must be spaced close enough to support the base properly without distortion. Put a steel plate under each jack bolt to distribute the weight and make adjustment easier.

USE LEVELING PADS

Experience proves that the best procedure is to use leveling pads and sheet-metal shims because: (1) They are cheap and easily obtainable. (2) They give adequate support to the base during leveling, alignment and grouting. (3) Foundation bolts can be tightened against them to take out twists in the machine and hold the parts securely during grouting and until the grout has set. (4) Shim stock can be readily obtained in any thickness from 0.002 in. up so combinations can be made from ordinary sheet steel. (5) Shims are left in place when the grout is poured and thus prevent any shifting because of improper grouting or shrinkage of the grout when it hardens.

The foundation's top surface should be rough enough to give a good bond for the grout. If it is not, roughen it with a point or cape chisel, leaving enough rough pockets to key the grout to the foundation.

Foundation elevation should allow for at least one inch of grout between the bedplate and foundation pads to give necessary resistance to cracking or crumbling, and tensile strength to tie the parts to the foundation.

Leveling Pads. On the foundation, mark location of the necessary leveling pads. Remember all bedplates are flexible and require ample support. Have too many leveling pads rather than too few. Distribute them so they are directly under bedplate where weight of machine parts comes. Have as many under inside of bedplate as on outside.

Obtain as many pieces of ⅜- or ½-in. steel plate or bar stock, 2x4 in., or larger, as there will be leveling pads. Clean top of foundation, removing all loose particles and dust, and wet it thoroughly. Put a shovel full of stiff grout on the spots marked for the leveling pads, and set one of the steel plates in each spot of grout. Set them level and to the same elevation, using a wye level and target or a straight edge and spirit level. Have the top surface of the steel plates about ⅛ in. below the bottom of the bedplate or foundation pads.

If you doubt the accuracy of the straight edge, erect a temporary support in the center of the machine's location for one end of the straight edge. Attach the spirit level securely to it and swing the combination in a circle, using the outer end to set the pads. Any error in the straightedge, level combination will thus be cancelled out, and the pads will all be at the same elevation. They may be higher or lower than the central reference point by any error in the straight edge or level, or both. What matters is that the error be less than the ⅛ in. allowed for the leveling shims.

Grouting. Forms to hold the grout must be light and strong, and high enough to give a good depth of grout over the lower flanges of baseplate or pads—at least several inches. If the baseplate permits, carry the grout to its top and fill it inside. Drill holes in top of bedplate or insert bent pipes under its bottom so air can escape from all blind pockets and the grout flow in. Bricks set in lean mortar make a cheap and satisfactory grout form. When the grout has taken its first set, they can be removed.

Remember grout is heavy and you may want to ram or puddle it under the bedplate, so have the forms plenty strong, especially along the edge of any inside pit. Put temporary plugs in all the tapped holes in the bedplate or pads so they cannot be filled with grout.

Cement Compounds. There are several compounds to reduce grout shrinkage when setting, as well as to increase the strength. Manufacturers of these compounds give instruction and advice gladly, so consult them.

For very large units that need a large amount of grout, use old cement. It sets slower and with less temperature rise than new. The temperature rise of new cement may cause distortion by expansion of metal parts.

Blow, sweep or vacuum all loose dust and particles from foundation and the bedplate. Thoroughly wet foundation before grout is poured.

Failing definite instruction, use a mixture of half cement and half clean, sharp sand. Loam in the sand weakens the grout and should, therefore, be avoided. Use washed sand if you can get it. If you must use unwashed sand drop a handful in a pail of clean water. If you can see the bottom of the pail inside of 10 min the sand is clean enough as is. Mix the grout as dry as you can and place it inside the bedplate by ramming or puddling. The cement may separate if too much water is used.

Self-Contained Units. Small or medium-sized self-contained units such as motor-generator sets or synchronous-converters do not need as large an amount of grout as a motor or generator that delivers or receives power along its shaft. Surplus grout may be removed along the edges of a bedplate when the grout has taken its first set, which is usually 8 to 10 hr after pouring.

WHEN GROUT IS SET

Judgment must be used in deciding when the grout is hard enough to take additional weight. If leveling pads and shims have been used so bedplate or foundation plates are evenly and solidly supported, metal-to-metal assembly of the machine may be safely started earlier than if wedges have been used. Characteristics of the cement as to the time required to reach sufficient strength must be considered. It may take 5 to 10 days or longer before the grout carries additional load safely. If there is any doubt wait a day or two longer.

Leveling. An accurately ground vial spirit level should be part of every erector's tool equipment. It serves for the smaller units and can be used with a straight edge for larger ones. But accurate straight edges are expensive and easily damaged, which limits their use. Where a central reference point can be established, as on a waterwheel-coupling face of a vertical unit it may be advisable to use it.

Bolt to the coupling a support of a height equal to the distance between the operating height of the coupling face and top of the stator frame. Allow for the amount that the waterwheel runner must be raised for operating clearance. Take any convenient straight edge, even a mason's wooden one that is reasonably straight, fasten a spirit level to it, place one end on the center support, Fig. 5, and swing the combination about the center support while the stator is adjusted until the level bubble is centered. By keeping the same end on the center support, the stator can be made absolutely level, but may be too high or too low by any error in the level and straight edge.

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

12—Battery Chargers and Thyratrons

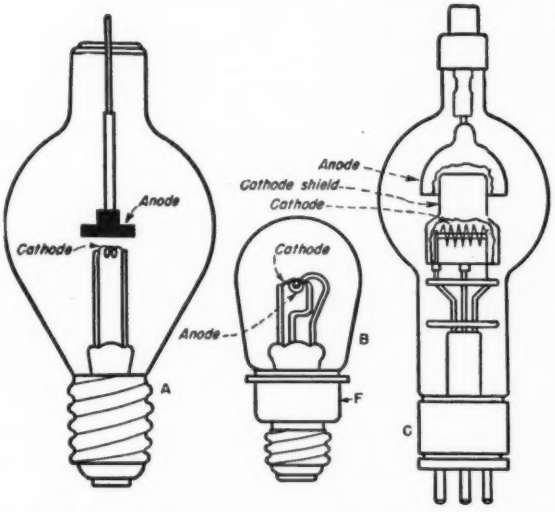
► CHARGING STORAGE BATTERIES is one of the extensive uses of medium-sized electron tubes. Special tubes, such as those marketed under the trade names of Tungar and Rectigon, are designed especially for this purpose. These are 2-element gas-filled tubes with a comparatively large directly heated thoriated-tungsten cathode. This cathode is heated to temperature that yields many times the electron emission normally obtained in a high-vacuum tube. After the tube has been evacuated, argon is added to a pressure of about 2 in. of mercury to prevent evaporation of the cathode at its high operating temperature.

Gas-Filled Tubes. Some of these tubes, used for currents up to 20 amp, may contain both argon and mercury, or only mercury. They have carbon anodes of two general designs: 2- to 15-amp sizes, Fig. 1*A*, and 5-amp size, Fig. 1*B*. Both designs have a screw base with the cathode connected to it as the filament is in an incandescent lamp. In Fig. 1*A*, anode connects to the bulb top, while in Fig. 1*B* it connects to an insulated ferrule *F*, on which an external contact rests.

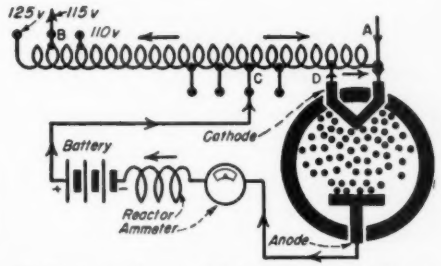
Fig. 2 is an elementary diagram of a 2-element gas-filled tube connected to charge a battery from an autotransformer. A reactor in the charging circuit smooths out the pulsating current flow to the battery. Taps on the left-hand end of the transformer permit using the charger on 110- 115- or 125-v ac circuits. Taps brought out near the center of the transformer are used to adjust the voltage for different numbers of battery cells.

Assume that current flows in on line *A* and out on line *B* and that the cathode has been heated. Primary circuit of the transformer is then from *A* to the cathode and anode, through the battery, into the transformer winding at *C* and out at *B*, as indicated by arrowheads. Current flowing in the transformer primary induces a voltage in the secondary section opposite to that in the primary, shown by the arrow pointing from *C* to *A*. Secondary winding from *D* to *A* supplies cathode-heating current. Part of the current to charge the battery comes from the secondary winding, the circuit being from *C* to *A*, through the tube and battery, back to *C* with the primary cur-

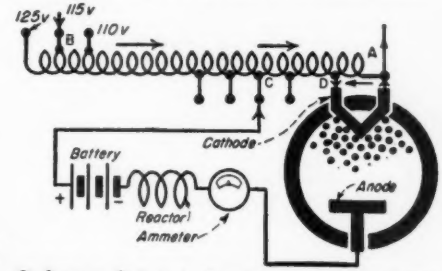
Battery-Charging Tubes and Circuits



1 Tubes for charging batteries. *A*: This gas-filled tube has a carbon anode in ratings from 2 to 15 amp. *B*: A small gas-filled tube for ratings from 1 to 5 amp. *C*: Another design of hot-cathode tube for charging batteries with the cathode made of metal ribbon that is coated with oxide. It is wound on the edge in a spiral



2 Elementary diagram of 2-element gas-filled tube connected to charge storage battery from autotransformer



3 Same as 2, but circuit polarity is reversed. During period, anode is minus; current can't flow in tube

rent. This is a half-wave rectifier, as explained in March POWER, p. 126.

When the polarity of the circuit reverses and current flows from *B* to *A*, Fig. 3, it cannot pass from anode to cathode of the tube so this part of the circuit is open. Magnetizing current for the transformer flows from *B* to *D* and through the cathode to *A*. Current induced in the secondary *DA* flows from *D* through the cathode to *A* and through the secondary winding from *A* to *D*. Thus even though the tube does not conduct battery-charging current its cathode is heated.

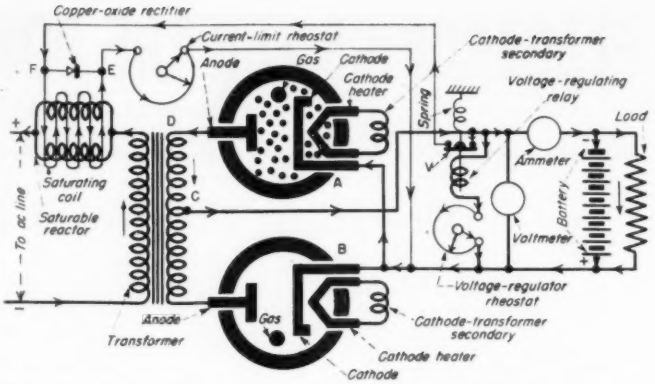
Storage Batteries. When connecting a storage battery to an electronic rectifier the minus terminal goes to the tube's anode. This is done because discharge from a battery is from − to + terminal and not from + to −, as generally assumed. Therefore, charging current flows through the battery opposite to the usual assumed direction. This is taken care of, however, in the charger so that + terminal of the battery connects to + on the charger and − battery terminal connects to − on the charger.

Phanotrons are also used in battery-charging sets, when current requirements are about 30 amp or less, and battery voltage is 120 or higher. They are a 2-element gas-filled design, but at a lower pressure than the two designs previously mentioned. In general, low-voltage argon or neon tubes used for battery charging have a pressure in them of about 0.75 in. of mercury. Other designs have a drop of mercury in them that partly vaporizes when the tube is put into service.

Battery-Charging Tubes. Fig. 1*C* shows one design of phanotron tube. It has a hot cathode made of oxide-coated metal ribbon wound on edge into a spiral. Sometimes the ribbon is corrugated to increase the electron emission. The anode in the larger capacity tubes is a carbon disk, and in smaller ratings may be made of carbonized metal. The design, Fig. 1*C*, has a glass envelope with a standard electron-tube base. Larger designs have metal envelopes.

Fig. 4 is a diagram of an automatic battery charger for 120 to 140 v. It is readily adjustable over a wide range making it possible to trickle-charge the battery after it is fully charged. The adjustment is also useful for stepping up the charging rate when the battery becomes discharged on excessive overloads and must be recharged at a high rate.

The charger is full-wave with two tubes, *A* and *B*, that have indirectly heated cathodes, heated from a cathode transformer. To simplify the diagram, only the secondaries of the cathode



4 Diagram of an automatic battery charger for 120 to 140 v. The battery can be started at full charging rate. After being fully charged, it is trickle charged

transformer are shown. A voltage-regulating relay with contacts enclosed in a vacuum makes and breaks the circuit to the coil of a saturable reactor to control the battery-charging rate. Operation of a saturable reactor was explained in POWER, Dec 1948, p 129.

Assume the charger connected to a storage battery that requires charging and to the ac-power supply, the latter having an instantaneous polarity as shown. Current then flows through the transformer's primary, as indicated. In the secondary, current flows from tap *C*, through the battery, tube *A*, and to *D* terminal of the transformer.

When the battery requires charging, voltage across its terminals is not high enough to open contact *V* on the voltage-regulating relay and the spring holds them closed. Dc then flows through the reactor's saturating coil as indicated.

The reactor's degree of saturation is controlled by the current-limit rheostat. The more of this rheostat there is in the circuit, the lower the current flowing in the saturating coil; consequently, the higher the reactance of the ac coils, and the lower the battery-charging rate. Reducing the resistance of the current-limit rheostat increases the saturation of the reactor and increases current flow to the battery. The current-limit rheostat is set to limit the rate of battery charging to a predetermined value, up to safe current capacity of the tubes.

Voltage Regulator. Setting the voltage-regulator rheostat determines the voltage at which the voltage-regulating relay opens its contacts. The higher the resistance in series with this relay's coil, the higher the battery voltage before the relay's contacts open.

As the battery becomes charged the voltage-regulating contacts continually open and close to maintain practically constant voltage across the battery until it is fully charged. When this happens, contact *V* remains open. In this way the battery is charged at a high rate at first and tapers off toward the end of the charging period. The regulator will hold the voltage across the battery within plus or minus 1% when the ac voltage varies plus or minus 5%.

A load may be connected across the battery, as shown. During heavy loads the charger holds the battery supply power, whereas during light-load periods the charger supplies the load and charges the battery.

In modern battery chargers like Fig. 4, the vibrating voltage-regulator relay has been replaced by an electronic self-regulating output voltage control. These, like the design described, charge storage batteries and automatically maintain them charged. In addition to providing the trickle-charge current necessary to keep the battery in a continuous state of charge, the charger supplies within the limits of its output rating the current drain of the load connected to the battery.

A copper-oxide rectifier connected across the saturating coil terminals absorbs the inductive kick of the saturating coil when the voltage-regulating contacts open. This rectifier conducts from *E* to *F* only, so during normal current flow through the saturating coil no current flows through the rectifier. When the voltage-regulator contact starts to open, the current decreases in the circuit and induces a voltage in the saturating coil that tends to keep current flowing. This current flows from *E* to *F* through the rectifier instead of causing sparking on the voltage-regulator contact.

Thyratron Tubes. A thyratron, one

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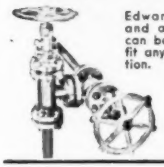

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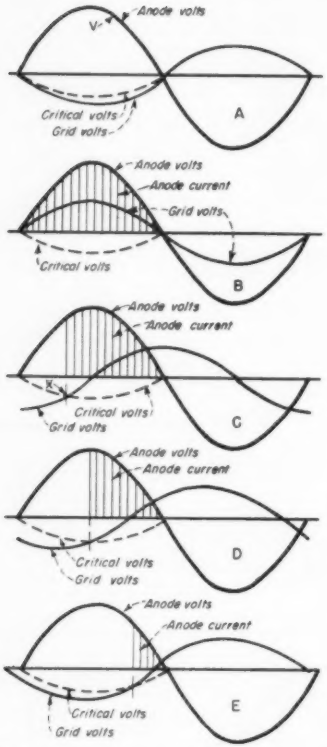
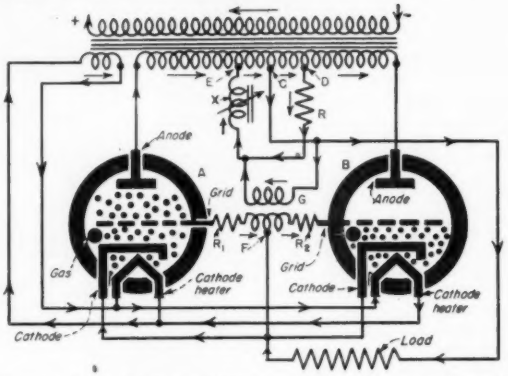
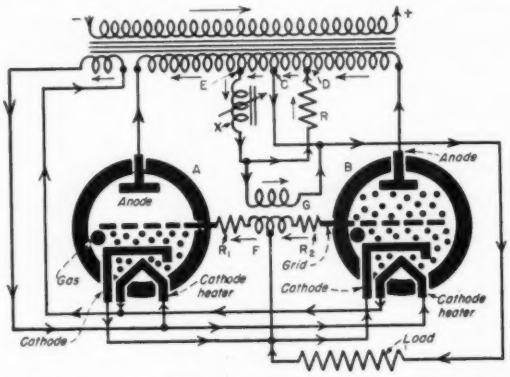
Grid and Anode Voltage Waves and Thyratrons



5 Grid and anode voltage waves. *A*: grid volts in phase with critical volts; tube does not conduct. *B*: grid volts in phase with anode volts, tube conducts. *C*, *D* and *E*: When grid voltage wave crosses critical voltage curve, the tube conducts



6 Diagram above shows two thyratrons connected in a rectifier circuit. The grid voltage is controlled by a resistor and reactor in series



7 This diagram is the same as 6, above, except that the transformer polarity is reversed. Thus tube *B* supplies load current instead of *A*

of the most versatile of the electron-tube family, is a hot-cathode gas-filled tube with one or more grids to control the starting of the anode current. The tube contains a large drop of mercury that partially vaporizes to gas. Gas pressure in the tube corresponds to the vapor pressure of the mercury at a given temperature. That is, for a given temperature in the tube the mercury evaporates until the gas pressure equals the vapor pressure of the mercury at that temperature, when evaporation ceases. For best operation the tube's temperature should be kept within certain limits. At low surrounding temperatures a thyratron may not pass its rated current where at high temperatures it will not rectify well.

By changing the potential on the grid of a high-vacuum tube, its output can be regulated from zero to maximum. At a given value and polarity of the grid potential, with constant cathode and anode conditions, a given current will pass through the tube. In a thyratron the grid can prevent the tube from passing current, but after the current starts to flow it no longer has control. The grid can get control again only when the current passes through zero as in an ac circuit.

Grid Control. When an ac voltage *V*, Fig. 5*A*, is applied across a thyratron tube in a direction to make the anode positive, the tube will not conduct if the grid is maintained more negative than a critical voltage, as shown. This critical negative voltage is indicated by the dotted curve. Critical voltage is zero at zero values of the voltage wave, and maximum at maximum value. As long as the grid remains negative at a voltage above the critical, as in Fig. 5*A*, the tube acts like an open switch in the circuit.

If the grid voltage is made positive and in phase with a positive anode voltage, Fig. 5*B*, the tube conducts during the entire voltage wave, indicated by the cross-hatched area. In fact, the tube performs very much as if it did not have a grid.

Anode current is controlled by shifting the grid voltage out of phase with the anode voltage as in Fig. 5*C*. Here the grid voltage curve going toward positive crosses the critical grid voltage curve at *X*. This makes the grid less negative than the critical value and the tube begins to conduct. It does so for the remainder of the voltage wave, shown by the shaded area.

If the grid voltage is shifted out of phase so it crosses the grid critical voltage curve at its maximum value, Fig. 5*D*, the tube conducts only during the last half of the anode-voltage curve.

(*Continued on page* 158)

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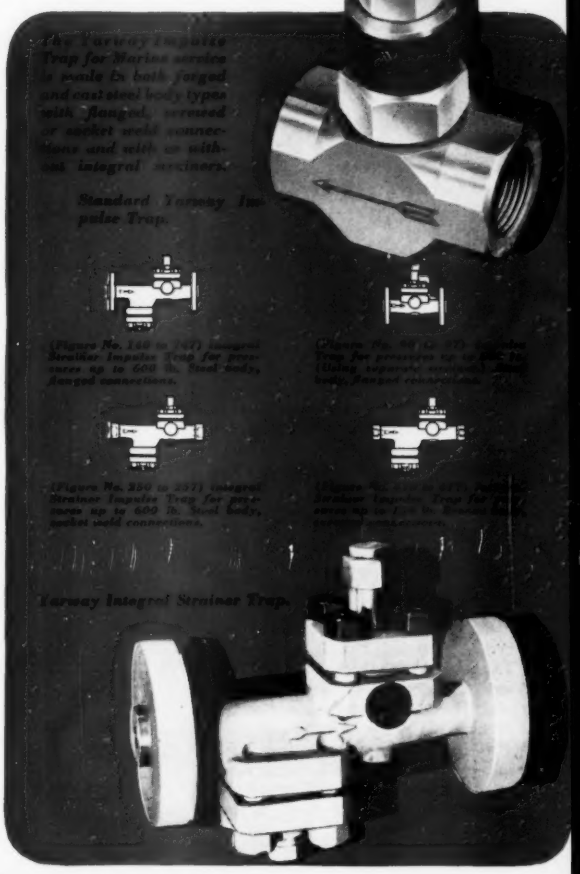
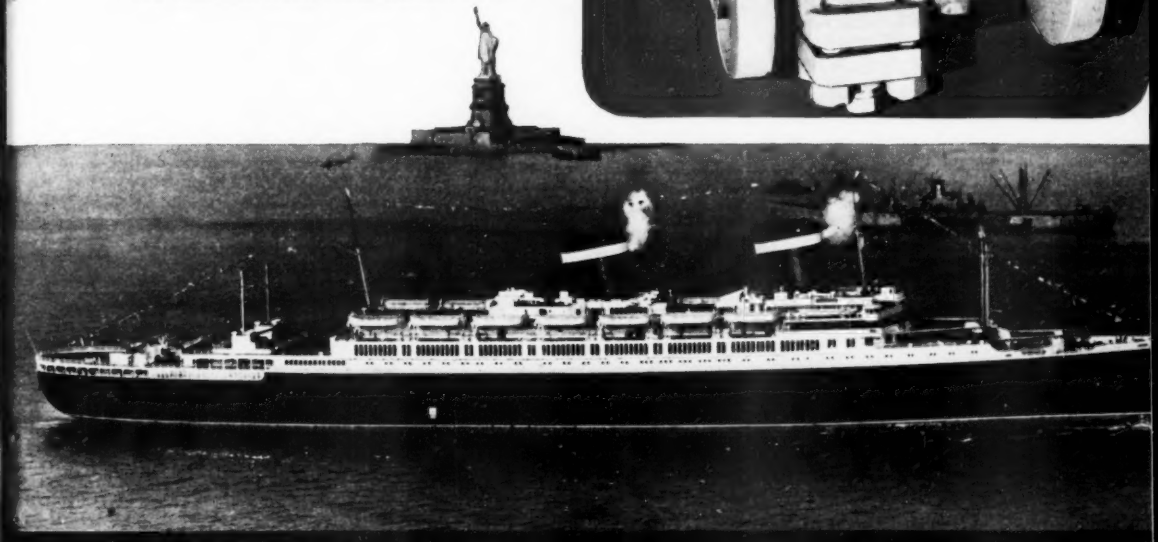

The Yarway Impulse Trap for Marine service is made in both forged and cast steel body types with flanged, screwed or socket weld connections and with or without integral strainers.
Standard Yarway Impulse Trap.
Yarway Integral Strainer Trap.



YARWAY IMPULSE STEAM TRAP

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

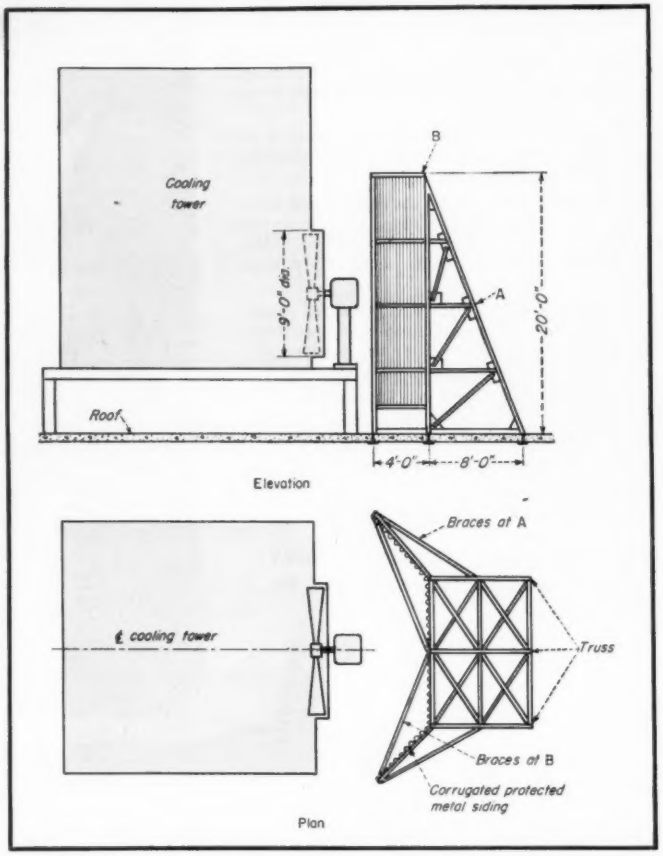
SOUND RETARDER ELIMINATES FAN-NOISE NUISANCE

IN ONE OF OUR PLANTS, a large cooling tower was installed with its fan suction facing a big residential area. No particular problem was anticipated, but shortly after initial operation a number of complaints were received regarding noise that was traced to our plant. Investigation revealed that during the day this noise was drowned out by normal street traffic, but at night a droning sound resembling a flying airplane resounded throughout the neighborhood. There was no doubt that the noise came from the forced-draft fan of the new cooling tower on our plant roof.

The sound-retarding baffle shown in sketch, right, was erected in front of the fan suction. It completely eliminated the noise nuisance. The sound shield was made of a corrugated sheet iron coated with bituminous and felt, factory applied, fastened to a framework of structural steel angles supported by three vertical trusses and tied to the roof with 1-in. dia bolts. The bolts passing through the roof deck were made watertight by constructing pitch pockets around them and sealing with pitch.

A similar noise nuisance from a fan in the wall of the same building, which faced a row of apartment houses, was overcome by placing a shield in front of the fan. The shield was made of 16-gage galvanized sheet steel, lined with 2-in. cork block insulation faced with asphalt. It was mounted about 8 inches in front of the fan discharge from the building. Both of these devices have given full sati-faction since their installation.

MILTON N KRAUS *Sunnyside, N. Y.*



ELECTRIC ARC WELDER CUTS REINFORCING RODS

WE HANG MUCH of the equipment in our building from the reinforced-concrete ceiling. Hitting the steel reinforcing rods when drilling holes in the ceiling for mounting the apparatus always posed a serious problem. After unsuccessful attempts to burn through the steel with an oxyacetylene torch we would have to abandon the hole. In a deep hole it was difficult to concentrate the flame on the steel, and when melting did occur the slag would fall on the burner tip.

We discovered that all the reinforcing rods are well grounded. By hooking the ground lead to the nearest pipe (checked for grounding) we can use our arc-welding equipment, reverse the polarity, and turn the current to maximum. Pushing the welding rod into the hole melts out the reinforcing rod in a few seconds. On a 1500-ft conveyor job we have saved many hours of unnecessary drilling.

E. WEINSHENKER
Long Island City, N. Y.

(*Continued on page* 132)

NO SLUDGE, NO RUST, NO CORROSION

Sunvis 900 Oils Still Like New After 3 Years' Service — Gears and Bearings Show No Wear

In October 1945 a paper mill started up a turbine which had been idle during the war. Sunvis 900 Oils were put in the circulating system and the bath-lubricated gear reduction unit. The operating temperature was about 140°F.

Today, nearly three years later, this equipment still runs on Sunvis 900 exclusively. It requires little makeup. The oils go unfiltered and untreated. No sludge has formed. During the last two summers the equipment stood idle for a few months, exposed to inevitable condensation. Inspected recently, the gears and bearings showed no measurable wear, and were free from rust and corrosion, despite the intermittent operation. The oil is in excellent condition, although never changed.

In all major industries, similar excellent results are being obtained by companies which have adopted Sunvis 900 Oils for preventive maintenance. Sunvis 900 Oils are fortified to resist deterioration and to protect metal parts against rusting and corrosion. These long-lasting, top-quality oils *keep productive machinery running longer*. They can do the same for you. Call your nearest Sun Office, or—for a copy of the illustrated booklet "Sunvis 900 Oils"—write Department P-4.

SUN OIL COMPANY · ***Philadelphia 3, Pa.***

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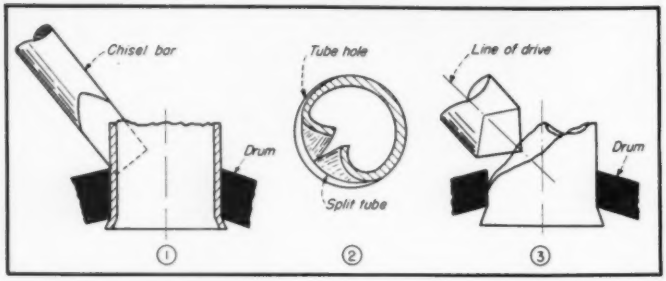
SUN PETROLEUM PRODUCTS

"JOB PROVED" IN EVERY INDUSTRY

SUNOCO



HOW TO REMOVE OLD BOILER TUBES QUICKLY

WE HAD TO MOVE our No. 1 boiler from an old building to the new power plant. This required taking the unit apart completely. When reassembling the boiler, new tubes and brickwork were used. We developed our own methods of removing the old tubes.

The tubes were cut off with an oxyacetylene torch at a distance equal to the seat thickness, plus one inch from the outer side of the drums. This allowed enough length to loosen the tube in the seat and to cut off the end. The end became battered from the backing-out tool and if we had attempted to drive it through the seat the latter would have been damaged.

The backing-out tool was made from a piece of steel the same diameter as the tube and about 12 in. long. One end was turned down for a distance of 1½ in. to fit inside the tube, leaving a square shoulder to seat against the end of the tube being driven out. The shoulder was case hardened. This procedure was adequate for the tubes on the lower 18-in. mud drums.

With the 42-in. dia steam drum we had better results when shrinking or splitting the tube. A quick heating of the tube interior with an oxyacetylene torch usually shrank it enough to permit driving it out. When this was not successful the tube was split as shown in the sketch at the left. (1) The tube stub is split with a cold chisel and sledge hammer. (2) Then a heavy diamond-pointed chisel bar is placed against the tube edges near the slit to drive them toward the tube center. When these edges have been driven to the center line or beyond (3) the stub diameter will have been reduced enough to permit driving it into the drum with little damage to the seat serration.

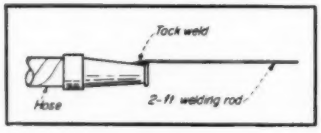
Holes that were damaged were repaired by welding. The low-carbon steel drum was preheated at the seat groove to about 150 F and ⅛-in. dia mild-steel covered electrodes were used. The weld metal was ground smooth and a reamer passed through the repaired holes.

JOHN R BROWN *Bauta, Cuba*

HOW TO ELIMINATE STATIC ELECTRICITY HAZARDS

QUITE OFTEN in our plant we must steam out the residue remaining in a storage tank or container that had previously held a volatile combustible such as fuel oil, acid sludge or tar oil. When doing such a job watch out for electrostatic charges! A steam nozzle generally does the job of emulsifying and washing away the material to be drawn off by a pump for convenient disposal.

Use a steam hose made of rubber and canvas, and wind a special hose wire spirally around it to the ends.



Attach one end firmly to the nozzle base and the other end to a grounded wire or pipe. The wire will dissipate any static electricity formed. Without this precaution, static discharges from the hose can ignite the vapors in the tank or container with disastrous result.

Under some conditions it has been found that even though all metal hose parts were grounded, static charges would still build up at the nozzle outlet. To dissipate these a long thin wire made up of welding rod was welded to the nozzle tip as shown in the sketch, left. Since static charges will always flow off any sharp-pointed end, this served to dissipate them in a safe manner.

J D CONSTANCE
Cliffside Park, N. J.

USING BOILER AS RADIATOR SPEEDS CONSTRUCTION JOB

THE STRUCTURAL-STEEL WALLS, roof and windows of an additional power-service building for a hospital were completed and most of the new steam equipment, boilers included, were in place. Cold weather set in suddenly and further inside construction work was impossible without space heating.

The existing boilers in the hospital had enough capacity to produce heating steam above their usual load; the problem was to lead this steam into the new building for heating. The two new 150-hp boilers were set in place, but the stoker and boiler front were not installed. The main steam header and blowoff lines were connected.

Traps were placed at the end of the blowoff lines to drain condensate and a temporary connection was run from the new header to the old boilers. Steam was then led into the new boiler drums and tubes that were exposed, thus providing radiating surface. With about 50-psig steam in the boilers we had sufficient heat for the boiler-room floor area and three upper floors so all trades could work comfortably.

Building area is about 60 by 70 ft. When the new heating system is completely piped it will take little time to change over to the new boilers.

F H KINDL *Kenmore, N. Y.*

Troubled with water problems?

SCALE
FOAMING
CORROSION
ALGAE
EMBRITTLEMENT
PRODUCT CONTAMINATION
STREAM POLLUTION

As an engineer responsible for efficient plant operation, are you troubled by these industrial water problems? If so, the Betz Organization can be of assistance to you. Here, in one organization, you will find the facilities and services necessary for the efficient solution of all industrial water problems. Wherever your plant may be located, our nation-wide staff of engineers is ready to serve you. May we have a Betz engineer call to discuss your specific problems? There's no obligation, of course. W. H. & L. D. BETZ, Gillingham and Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

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PROBLEMS FROM THE PLANT

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

IS PRESSURE RISE IN CONDENSER CIRCULATING WATER SIGNIFICANT?

WE HAVE BEEN OPERATING our condensing turbine for many years but it was only recently that we noticed an unusual condition. When the turbine is up to speed, pressure of the circulating water increases about 5 lb.

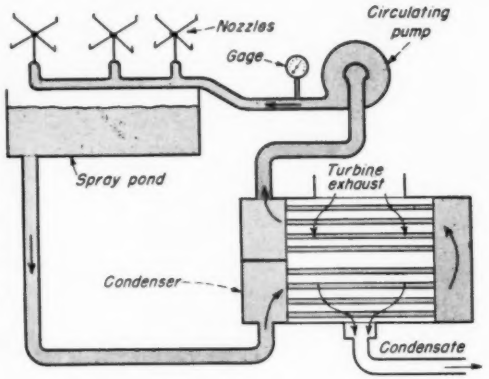
Sketch to right shows the general layout of condenser, circulating pump and spray pond for cooling condenser water. The condenser we own handles 14,000 lb of condensate per hr at 28-in. vacuum.

About 1500 gpm of circulating water is used at 70 F. The condenser has 1250 sq ft of cooling surface and is designed for two passes of the cooling water. As usual, the turbine exhaust surrounds the cooling condenser tubes.

We run into many problems from time to time but this one has us stumped. We can't see how the turbine's running affects pressure of the circulating water.

We have been toying with the idea that expanding the condenser tubes might be the answer to our problem although we fail to see the logic of this move.

Perhaps POWER readers have met up with a similar problem or can dope out the right answer for us.—*BC*



READERS' ANSWERS

What Causes Boiler Tubes to Plug?

(This question is from Jan issue with best answers from readers.)

WE ARE HAVING *tube trouble with one of our oil-fired Stirling boilers, rated at 2870 sq ft. Boiler is 18 tubes wide and 12 deep; all tubes are 3¼ in. in diameter.* [*See sketch, p.* 114, January, POWER.]

Our problem centers around the front row of tubes in the second bank. We found five tubes in this row plugged, holding water when boiler was empty. One tube bowed to extent that end of tube, ordinarily rolled within drum, had pulled to a point where its end was level with inner surface of drum.

An inspector from the company handling our feedwater problem, in addition to the boiler manufacturer's representative, was consulted but we have received no satisfactory answer to date.

Feedwater is checked at least four times each week. Samples have been sent to the feedwater company's home office and water has always been found up to standard. Analysis below is of deposit taken from plugged tube in center bank. I would certainly appreciate getting the thoughts and experiences of other POWER *readers on this matter.—SW*

Analysis of Tube Deposit, %

Iron and alum oxides	3-5
Calcium oxides	36
Magnesium	5
Net ignition loss	7
Sulphur trioxide	14
Carbon dioxide	7
Phosphorus pentoxide	12
Silica	16

Note: There was no evidence of sulphides, while amount of magnetic iron oxide and water soluble material was negligible.

Suggests Adding Water Tubes

SW's BOILER is a Connelly design, not Stirling, as stated. Water circulation is upward in front-tube bank, through front drum to middle drum and, theoretically, downward through middle bank. Feedwater enters rear upper drum, passes downward through rear bank to lower drum, and merges with main circulation as required.

Baffle arrangement shown causes impingement of relatively hot gas on a considerable length of front tubes in middle bank, causing steam to be generated. Buoyancy of steam bubbles then opposes downward water flow. Resulting poor circulation favors precipitation of suspended solids on inside surface of tube, which is subject to rapid heat absorption—an ideal condition for eventual plugging of tube.

Action described can be corrected by adding one, or preferably two, rows of water-circulating tubes between upper middle and rear drums. This will divert part of upflow from front bank to rear bank, permitting middle bank to establish its own circulation according to heat absorption. In front tubes of middle bank, circulation definitely will be upward, eliminating tendency of suspended solids to settle on tube surface. Any zones of stagnant circulation will occur toward rear of middle bank where heat absorption is less active, and location of such zones will shift with variation in steaming rate.

Assuming final water treatment is internal, especially if fed intermittently, another benefit from suggested water-circulating tubes is that all water in the boiler will be treated more uniformly and thoroughly. Depending on characteristics of water treatment, this may well result in such conditioning of sludge to reduce tendency of particles to agglomerate.

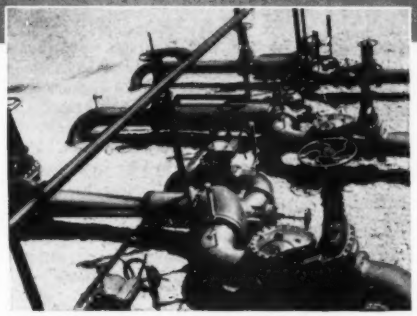
G R LYON *Birmingham, Mich.*

EDITOR'S NOTE: *Mr Lyon may very well be right in identifying the boiler shown on p 114, January, as a Connelly design. The drum-and-tube arrangement is a type generally indicated in the industry as a Stirling type.*

(Continued on page 136)

From Coast to Coast...

SK Gas Jet Compressors Provide Dependable, Low-Cost Service



A Typical SK Gas Jet Compressor Installation at the Plant of a Large Gas Company.

For dependable, continuous service . . . for an absolute minimum of maintenance . . . for lower initial cost, lower operating cost and maximum efficiency—gas companies from coast to coast are turning to SK Gas Jet Compressors.

Operating on the jet principle, these compressors mix Propane and Butane with air, natural gas with air or natural gas with manufactured gas in proper proportion to obtain desired heating value. The simplicity of operation, the lack of rotating parts and the ease in adjustment so characteristic of the jet make these compressors ideal for continuous operation or for peak load shaving.

SK Gas Jet Compressors are custom-built—can be designed for your particular problem. It will pay you to investigate their advantages for use in your own operation or, if you are already using these compressors, it may pay to add to your present installation. Write for complete information.

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Why Not Check the Firing?

DEPOSIT DESCRIBED in *SW*'s analysis is formed from sludge formerly suspended in boiler water. This sludge settles out where circulation rate is too low to keep it diffused in water. Rapid positive water circulation in front bank of tubes is due to lack of restriction between front and center upper drums. This in turn causes heavy down flow of water in center bank as no other recirculating path is provided.

At low loads on this boiler there is sufficient water recirculated downward through center bank to carry with it the relatively small quantity of steam formed. As load is increased steam formed in center bank increases faster than load; amount of recirculated water does not increase as rapidly. For each tube in center bank there is a load point at which upward circulating force, because of steam formation, will balance downward force of recirculated water. At this load, circulation will be alternately upward or downward as one force or the other becomes the larger. Sludge will deposit in tubes when this condition has been produced.

Trouble might be remedied by changing firing conditions. If flame is entering boiler, adjust burners to get complete combustion within furnace. Trouble is at a location where heat absorption is affected very little by changes in excess air, but any change in flame shape that increases heat absorption in front bank is of benefit.

Through changes in baffling or boiler circulating system, or both, it is possible to move point of balanced circulation to a lower gas temperature zone where tubes will not be damaged. Such changes should be made only on recommendation of a competent boiler engineer after thorough analysis of plant loads and operating conditions.

ROSS IRWIN

Rochester, Ill.

Check the Water Treatment

SW DOES NOT GIVE enough information for a complete diagnosis of his problem. Salient points to consider are: (1) boiler pressure and range of operating ratings (2) percentage of makeup and analysis of same (3) point where plugging occurs and where tubes are located in first row of middle bank (4) any evidence of flame impingement (5) method and schedule of blowdown (6) method and schedule of chemical feeding (7) method and schedule of water sampling and testing (8) internal condition of boiler balance (9) point of feedwater introduction and means of distribution inside boiler (10) operating schedule of boiler.

Scale analysis throws some light on the cause, but explanation is not complete. Component parts total a little over 100%, so presumably everything present was found and reported. Combination of the radicals is left to guesswork since a petrographic analysis did not accompany the report. In any event, the deposit consists mainly of calcium and magnesium compounds.

By combining the negative radicals of *SW*'s analysis first with calcium and using the balance of magnesium, the following hypothetical analysis is evolved:

Calcium sulphate	$CaSO_4$	23.8%
Calcium carbonate	$CaCO_3$	16.0
Calcium phosphate	$Ca_3(PO_4)_2$	25.8
Calcium silicate	$CaSiO_3$	6.4
Magnesium silicate	$MgSiO_3$	18.4
Iron & aluminum oxides	R_2O_3	3.5
Ignition loss	—	7.0

Calcium phosphate, calcium carbonate and magnesium silicate are ordinarily nonadherent. Calcium sulphate and calcium silicate are definite forms of adherent scale and give evidence of undertreatment of boiler water.

First corrective step is to supply sufficient soluble phosphate (PO_4) and caustic alkalinity (OH) in boiler water. From information given, 30 to 50 ppm of PO_4 and 50 to 80 ppm of OH should be sufficient. Lacking an analysis of either feedwater or makeup water, it is not possible to advise which form or amounts of chemicals to use.

Boiler water should be tested often enough to make certain proper conditions prevail continuously. Perhaps four tests a week are insufficient to develop the necessary information. Blowdown should be adjusted to minimize carryover and prevent undue sludge accumulation.

JAMES T POTTER

Charlotte, N. C.

Increase Bottom-Drum Blowdown

SOMETIME AGO we had an experience similar to *SW*'s. Front tubes in second bank drain most of the sludge and trash out of middle top drum. Ordinarily, sludge would flow down the tubes to bottom drum without any hindrance and be deposited in the bottom drum where it would be removed during blowdown.

Three things may cause sludge to settle out in tubes. (1) There may be a baffle in bottom drum at point where the tubes enter. In this case sludge may build up in baffle and obstruct flow from tubes. A solution would be cutting a hole in baffle near center of boiler permitting better circulation. (2) The comparatively sharp bend in tubes where they enter drum may cause trash to settle out. (3) Depending on rate at which boiler is being fired, these tubes may act as either "downcomers" or "upcomers." At a high rate of firing, circulation might be upward, whereas at a slow rate it would be downward. Possibly a good portion of the time circulation is sluggish, tending to precipitate solids.

It is my guess that the tubes become clogged right after boiler has been out of service and tubes and drums have been cleaned. When placed back on line there is much scale and trash which becomes partly loosened during cleaning process and completely free during warming-up period. Best solution is to blow boiler down frequently, say, once each hour even though normally it may not be blown down but once each day. Blowdown referred to is, of course, the bottom-drum blowdown and not continuous blowdown.

R L NALL *New Orleans, La.*

Advises Relocating Baffles

SW's TROUBLE is due to "steam blanketing" caused by short circuiting of high-temperature gases over low baffle on front-tube bank. Steam bubbles stop natural downward movement of water and rise to upper drum. Tube wall is left momentarily dry by each bubble, and suspended solids left by water are baked to the metal. These solids are nonsoluble; hence remain on tube wall.

Baffles were apparently designed for hand firing with a low stack draft. Front baffle was probably lowered to secure proper combustion through a heavy fuel bed on grates. *SW* should build up baffle for oil firing so its upper edge is 1½ to 2 times the distance from second baffle to lower drum, thus making the hot gases travel practically the full length of front-bank tubes. More heat is thus absorbed by front bank of tubes, resulting in better circulation.

HRARY E FLOWERS

Chattanooga, Tenn.

Two Solutions Are Offered

ANALYSIS OF MATERIAL in plugged tubes indicates that at times there is insufficient phosphate present, and some calcium sulphate scale may have formed. Assuming feedwater enters top near drum, I recommend a phosphate base treatment be injected directly into drum in addition to carrying total alkalinity as high as 400 ppm. This should produce a finer sludge dispersion and help prevent plugging.

Location of plugs indicates one of two things: either a delayed reaction of internal treatment or inadequate mud-drum blowdown. If first assumption is correct, above recommendation should correct the problem. If latter is true, set up a regular schedule for mud-drum

(*Continued on page* 174)

● Experimental laboratory condenser, with water boxes removed, designed by The American Brass Company and tubed with eight different copper alloys, as it appeared after 10-month test, July 28, 1947 to May 25, 1948, at the Marine Test Station of International Nickel Co., at Kure Beach, N. C. *(see above).*

ANACONDA Cupro-Nickel 754

(10 PERCENT NICKEL CONDENSER TUBE)

MANUFACTURED AND SOLD UNDER U. S. PATENT NO. 2,074,604

Shows High Resistance Under Accelerated Test

TEN months of testing with high velocity sea water at Kure Beach, N. C., demonstrate the superiority of Anaconda Cupro-Nickel 754 (nominal composition, copper 89.25 percent, nickel 10 percent, iron .75 percent) over a number of widely used condenser tube alloys.

The purpose of the test was to determine the resistance of various standard tube alloys to corrosion-erosion type of deterioration caused by turbulent flow of sea water. The tubes are .625" O. D., 18 gage (.049"), and 61 inches long. The average velocity of sea water flowing through the tubes, during the continuous 10-month test, was 11.7 feet per second. Water temperature varied from 45°F. to 85°F., according to the season of the year.

This test, and performance records where Cupro-Nickel 754 tubes have been in service under severe operating conditions, indicate that this tube and tube sheet alloy will give economical service for central station and marine condensers handling clean and some types of polluted sea waters. The American Brass Company welcomes opportunities to discuss problems relating to condenser tubes, and the services of its Technical Department are available for assistance in selecting alloys to meet specific operating conditions. 49185

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TECHNICAL BRIEFS

ENGINEERING DEVELOPMENTS HERE AND ABROAD DIGESTED FOR BUSY POWER MEN

REVIEWED IN THIS ISSUE

TRANSMITTED POWER

Roller Chain Designs and Applications
Hydrodynamic Transmissions

GAS FUEL

Sound Utilization of Gas
Effect of Natural Gas on Industry

HYDRAULIC UNITS

Hydraulic-Turbine Speed Regulations
Hydraulic Press Developments

Directions for ordering papers are given on page 140

TRANSMITTED POWER

ROLLER-CHAIN DESIGNS AND THEIR ENGINEERING APPLICATIONS, *by Joseph Joy, General Chain & Belt Co.* When the purpose of a roller-chain application is not wholly to transmit power from one shaft to another, or to lift weight, it is generally necessary to change the dimensions of the side plate or pins to adapt the chain to the functions required. The chain manufacturer may make the modification at the time of the original assembly, or the purchaser may make it later. Most service failures result from improper modification by the purchaser.

Selection of roller-chain drive for power-transmission is relatively simple. It is necessary to follow instructions in the chain maker's catalogs and handbooks, available for the asking. These give information on chain and sprocket dimensions, power and limitations. For power-transmission requirements not covered in the literature, it is wise to take advantage of the engineering service that all chain manufacturers offer.

For other uses of roller-chain, such as materials handling, it is necessary to adapt the chain to the function required, a responsibility primarily of the machine designer. This work must be done at the proper stage in the machine's design, and the general principles applied must conform to those of the chain itself. Otherwise the adapted section may not function as intended or may constitute literally weak links, adversely affecting the success of an otherwise satisfactory machine.

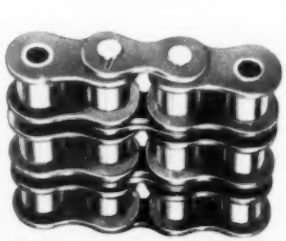
This paper presents information about roller chains for services other than the transmission of power, outlining some of their possibilities, and points out how to avoid errors in adaptation. Suggestions for simplification of design and how to take advantage of standardized adaptation parts, avoiding the necessity for extensive new tooling, are also included. *ASME Paper No. 48-A-66.*

HYDRODYNAMIC TRANSMISSIONS, *by John F Swift, Engineering Research Department, Ford Motor Co.* Fundamentally, the hydrodynamic transmission is composed of three elements—pump, turbine and reaction member. Each member can have multiple or sectionalized stages. Both stages may be used in many arrangements, with many circuit shapes, and with or without one-way or 2-way clutches or brakes. In addition, the characteristics of any hydrodynamic transmission can be greatly altered by gearing, or by dividing the total power being transmitted between gearing and one or more elements of the hydrodynamic transmission. We have, therefore, great diversity combined with simplicity. In the future we will undoubtedly have many developments of various forms of hydrodynamic transmission.

This paper develops a general understanding of the hydrodynamic transmission, so any one unit may be evaluated, no matter how strange its appearance or complex its structure. It shows how one basic design may yield various results with one engine when combined in different sizes, how the shape of the "K" curve and the unit size influence over-all results, how some gearing combinations affect over-all performance curves, and how torque characteristics of the engine itself affect performance.

In general, to achieve maximum results with a hydrodynamic transmission it is usually necessary and desirable to use mechanical gearing with the transmission. Where volume does not justify cost of designing and building a unit with specific hydrodynamic characteristics, the use of gearing is frequently necessary to achieve the desired over-all performance characteristics from the available hydrodynamic transmission. The hydrodynamic transmission, therefore, broadens the transmission field and hence can increase the use of gears in general, rather than decrease or replace them. *American Gear Manufacturers Association paper, Ford News Bureau, Administration Bldg, Dearborn, Mich.*

1 Roller-chains serve a number of applications as well as transmit power



2 When you select chains for material-handling, you need a special design

GAS FUEL

EFFECT OF INTRODUCTION OF NATURAL GAS ON A HIGHLY INDUSTRIALIZED TERRITORY PREVIOUSLY SUPPLIED BY MANUFACTURED GAS, *by Paul R Taylor, Stone & Webster Service Corp.* Every area approached by natural-gas pipelines shows keen interest in what effect natural gas will have on local industry. Here's a paper based upon experience and observation that delineates the results upon industries formerly served with manufactured gas and now augmented or adapted to natural gas. It can serve as a helpful guide to any area.

This is what the author has to say: Natural gas is now or will be within two or three years available in practically all large centers of industry in the United States. Its available reserves, according to the *Report of the American Gas Association Committee on Natural Gas Reserves,* published jointly by that association and the American Petroleum Institute, lists the proved reserves as of Dec 31, 1947 as 165.93 trillions of cu ft—an increase of 5.35 trillions over that of 1946 despite

Ready reference chart...

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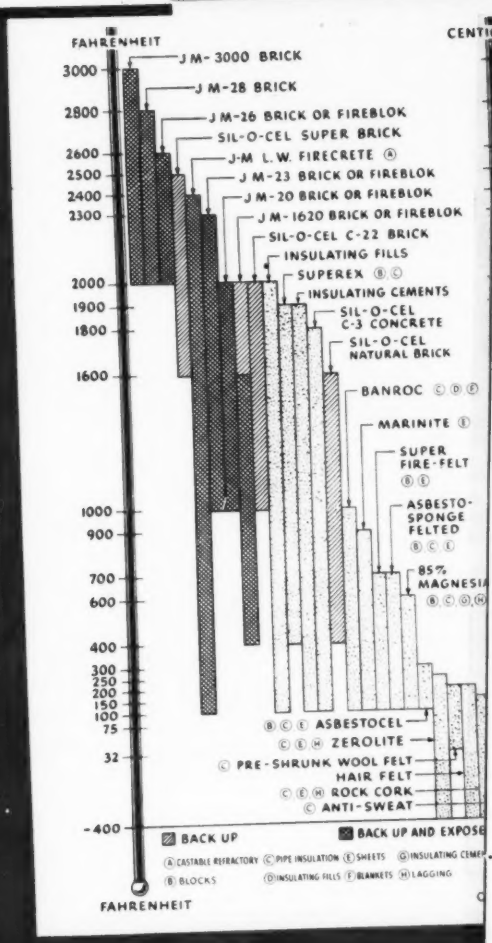

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a 1947 production of 5.63 trillions of cu ft.

In comparison with present-day costs of solid and liquid fuels, natural gas can be purchased for industrial purposes at a cost per therm considerably below competitive fuels. And these costs should remain fairly stable because earnings and rates of natural-gas companies are controlled by either Federal or State Commissions.

Industrial load on an interruptable basis is desirable as an offset to seasonal gas loads. Usually this type of load gets gas at a very attractive rate.

Labor and storage costs for fuel and fuel handling amount to relatively little. *ASME Paper No. 48-A-41.*

CONSIDERATIONS AFFECTING SOUND UTILIZATION OF GAS, *by Carl Wierum, Brooklyn Union Gas Co.* Over 65% of the 29 billions of therms (100,000 Btu) sold by utilities in 1947 went to industrial and commercial users. These users represent by number less than 10% of the total gas customers. In addition to the large quantity of gas supplied industry by utilities is the tremendous amount sold by pipeline companies, generated and used by refineries and steel companies, as well as the many distributors of bottled liquefied-petroleum gases.

Steps are now being taken to prevent what has been an appalling waste of this fuel. First step is bringing natural gas, formerly flared or burned off at the fields, within reach of millions of users. But there is still much to be done in improving use of this fuel in the individual plant. The author feels it must begin at the burner. He recommends adequate air, table above.

Next mixing. The commonest methods are (1) inspiration of air from atmosphere (2) inspiration of gas by air under pressure (3) premix systems where a premixed quantity of air and gas reach the burner under pressure.

The author follows up this plea for adequate air and proper mixing with a request for conformity to basic principles in the design of burner elements.

TO OBTAIN COMPLETE TEXT

Material in the briefs comes from one of these sources:

American Society of Mechanical Engineers, annual meeting, New York, Nov 29-Dec 3, 1948. Papers are identified by initials ASME and Paper No. Available at ASME, 29 W 39th St, New York 18.

American Gear Manufacturers Assn, fall semiannual meeting, Chicago, Oct 25-27, 1948. Paper is credited to association and reprinted from Ford News Bureau, Dearborn, Mich.

AIR REQUIREMENTS FOR COMPLETE COMBUSTION

Gas	Btu's/cu ft	Cu ft air/ Cu ft gas	Cu ft air/ 1000 Btu's
Liquefied petroleum	2500 to 3200	24 to 30	9.2 to 9.5
Natural	950 to 1150	9.5 to 10.5	9.3 to 9.4
Manufactured	500 to 600	4.4 to 5.2	8.6 to 8.7
Water gas	250 to 300	2.0 to 2.1	7.3 to 7.7
Producer gas	130 to 160	1.0 to 1.2	7.4 to 7.5

His last two pointers for better gas-burning are (1) proper application of burners to the job at hand (2) full use of automatic devices. *ASME Paper No. 48-A-42.*

HYDRAULIC UNITS

SPEED-REGULATION COMPUTATIONS FOR HYDRAULIC TURBINES, *by Robert Lowy, consulting engineer.* This paper describes a method for calculating speed-regulation values for hydraulic turbines. The approximate formulas used in the past were based on an average horsepower or average torque during the control procedure. Secondary influences have usually been neglected, as, for instance, for specific speed, runaway speed and position of the gate at full load. These factors may tend to compensate each other to some extent. Method described provides simple tables for computation and gives a means for checking results of field tests. A comparison is also given between the dual regulation of Pelton turbines and Kaplan-turbine regulation, which have similar control procedures and require special speed-regulation computations.

Dual regulation of turbines consists of an arrangement by which turbine speed is influenced by two control systems. Double regulation is used by impulse turbines only in the closing direction, and by Kaplan turbines in both opening and closing. Both control systems seem to be quite different, but they show a similar characteristic in their speed-control procedure.

Speed rise with dual regulation is generally quite different from that of turbines with single regulation. The reason is that during the controlling procedure a definite position of one controlling part does not correspond to a definite position of the other. This difference of position occurs only for a short time during the control period, but has an essential influence on speed rise.

Dual control shows a 2-fold influence. It increases considerably the maximum speed rise for large and medium loads thrown off, and it brings about a deviation in the speed fluctuation after the maximum speed rise has been obtained. This occurrence does not have its origin in the governor behavior—it is directly connected with the dual-control itself. *ASME Paper No. 48-A-37.*

PARALLEL DEVELOPMENT OF HEAVY SELF-CONTAINED HYDRAULIC PRESSES IN THE U.S. AND GREAT BRITAIN, *by F H Towler, Towler Bros, Rodley, England.* This paper surveys the parallel development of heavy, self-contained hydraulic presses in the U. S. and Great Britain, in the hope that an exchange of ideas may help further developments in both countries. The self-contained press has been made possible by the development of a compact high-speed pump using oil as the hydraulic medium, and the construction of the pump has considerable influence on the design of the press.

In the U. S., the tendency has been to use rotary-valve pumps operating at a maximum pressure of about 3000 psi, with a comparatively thick oil of around 300 saybolt and 100 F. In Great Britain there is a growing tendency to use seated-valve pumps for a working pressure of 7000 psi, using a thin oil of 60 saybolts at 100 F. The relative advantages and disadvantages are discussed.

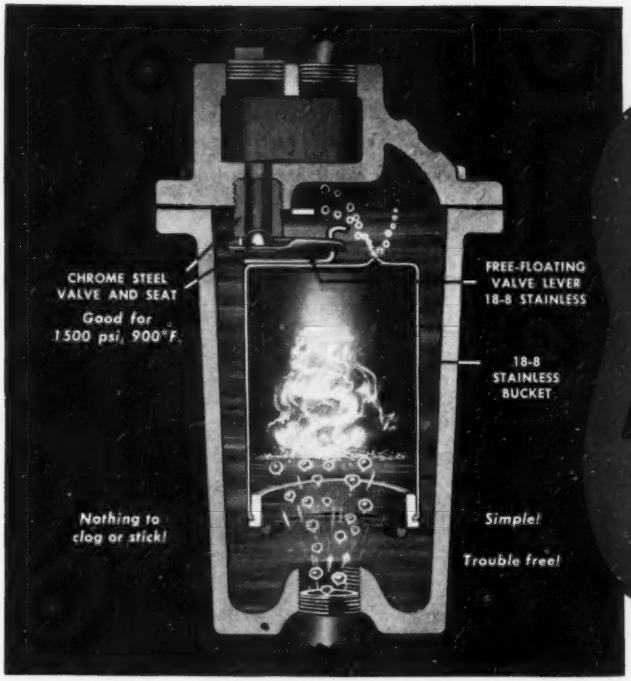
The U. S. was the first to develop the heavy self-contained hydraulic press around 1926. Development of a self-contained press required a high-speed hydraulic pump for 400 to 1800 rpm, of reasonably high pressure and sufficiently compact to be mounted in or on

(*Continued on page* 160)

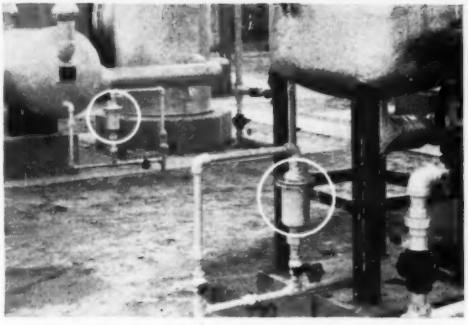
INDEX AVAILABLE

Copies of the index for POWER articles from January to December 1948 are available.

Single copies may be obtained by addressing Miss M Coffey, POWER, 330 West 42nd Street, New York 18, N. Y.



it isn't the cost or the upkeep with ARMSTRONG STEAM TRAPS



IF the first cost of Armstrong Steam Traps was high, which it isn't, they would still be a good buy because of low upkeep.* Maintenance on Armstrong Steam Traps is exceptionally low because:

1. Even in Armstrong Steam Traps for low and medium pressures, the valve and seat are chrome steel, hardened, ground and lapped to leak-tight fit —identical in materials and workmanship to those used in Armstrong traps for pressures to 1500 psi, 900°F.

2. The Armstrong free-floating valve lever mechanism is unusually resistant to wear because there is no friction and it is of heavy corrosion-resistant stainless construction.

3. Dirt is washed through the trap by the swirling action of the condensate—and out through the nice big valve orifice.

4. There is nothing to clog, stick, bind or collapse.

Add up these features and you arrive at a trap that very seldom needs maintenance—a trap that saves man hours and money—a trap that pleases everybody from the purchasing agent to the pipe fitter.

THE 36-page ARMSTRONG STEAM TRAP BOOK tells all about these traps, how to select and install them for long, trouble-free performance. Send for your copy.

*You get more hot condensate capacity with Armstrong Steam Traps per dollar of investment than with any others.

P.S. Because they don't leak steam, Armstrong Traps are excellent for saving fuel.

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POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

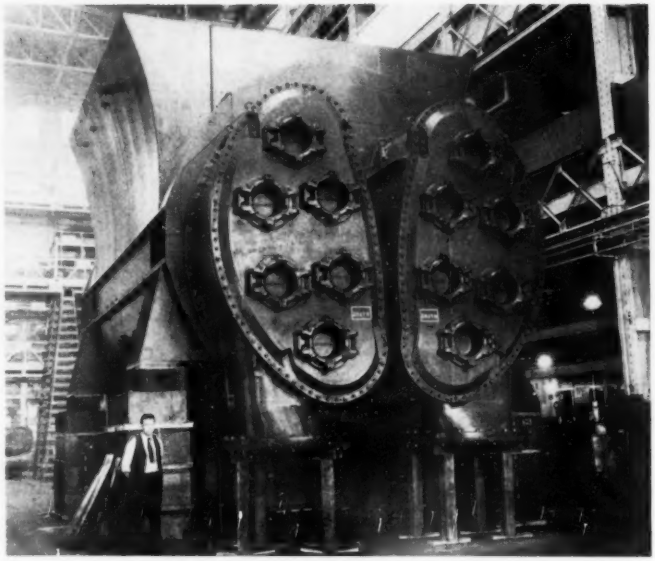
11th Annual Midwest Power Conference

► Conference Director Roland A Budenholzer has announced that the eleventh annual Midwest Power Conference will be held April 18-20 at the Sherman Hotel in Chicago. Dr Budenholzer, professor of mechanical engineering at Illinois Institute of Technology, was named conference director in September. He replaced Stanton E Winston, director of the conference since 1940, who resigned to devote full time to his duties as dean of the evening division and professor of mechanical engineering at Illinois Tech. Dr E R Whitehead, director of the department of electrical engineering at IIT, is conference secretary.

The annual 3-day meeting is sponsored by Illinois Institute of Technology with the cooperation of 18 Midwestern universities and professional societies. This meeting is considered the largest conference of its kind in the world. It attracts 2500 to 3000 engineers each year from all parts of the United States and Canada.

At the conference this year a great deal of time will be devoted to water treatment and associated problems. There will be discussions on boilers, transformers, network analyzers and analog computers, small power plants,

(*Continued on page* 192)



Single-Pass Divided Circulation Condenser

South end of Philip Sporn Unit No. 1 condenser at factory of Worthington Pump and Machinery Corp shows divided water box and access manholes. This 65,000-sq-ft condenser is one of six that have been ordered by American Gas and Electric Service Corp for 137,500-kw (net capability) cross-compound turbine-generator sets to operate on 2000-psi 1050-F (initial) 1000-F steam. Four of the condensers are for Philip Sporn plant and one each for the Twin Branch and Tanners Creek units

COMING EVENTS

Apr 11-12—American Institute of Electrical Engineers, conference on industrial applications of electron tubes, Hotel Statler, Buffalo. H H Henline, 33 W 39th St, New York 18.

Apr 11-13—American Society of Lubrication Engineers, meeting, Hotel Pennsylvania, New York, N. Y. W F Leonard, secretary-treasurer, 343 S Dearborn St, Chicago 4, Ill.

Apr 11-14—National Assn of Corrosion Engineers, meeting, Netherland Plaza Hotel, Cincinnati, Ohio. A B Campbell, exec secretary, 905 Southern Standard Bldg, Houston, Texas.

Apr 18-20—Midwest Power Conference, Sherman Hotel, Chicago, Ill. Roland A Budenholzer, conference director, c/o Illinois Institute of Technology, 3300 S Federal St, Chicago 16.

Apr 19-21—American Institute of Electrical Engineers, meeting, Baker Hotel, Dallas, Texas. H H Henline, secretary, 33 W 39th St, New York 18.

Apr 21-23—New York State Society of Professional Engineers, convention, Hotel New Yorker, New York. Edward J Quirin, Frederic R Harris, Inc, 27 William St, New York, N. Y.

Apr 25-29—Oil and Gas Power Div, American Society of Mechanical Engineers, meeting and exhibit, Hotel Sherman, Chicago. Joseph M Clark, manager, 29 W 39th St, New York, N. Y.

May 12-13—Instrument Society of America, fourth annual spring meeting, Royal York Hotel, Toronto, Canada. Ed Grace, Instrument Society of America, Pittsburgh 12, Pa.

May 19-21—Society for Experimental Stress Analysis, spring meeting, Hotel Statler, Detroit, Mich. W M Murray, Society for Experimental Stress Analysis, Box 168, Cambridge, Mass.

May 24-27—National District Heating Assn, 40th annual meeting, New Ocean House, Swampscott, Mass. John F Collins Jr, secretary-treasurer, 827 N Euclid Ave, Pittsburgh 6, Pa.

May 30-June 3 — American Water Works Assn, meeting, Hotel Stevens, Chicago, Ill. Arthur T Clark, secretary-manager, Water and Sewage Works Mfrs Assn, 170 Broadway, New York 7.

Laboratory illustration of good water treatment . . . and bad. Test rods, in same water, same temperature and circulation conditions, but only one with Nalco treatment added (left), show the improvement you can expect with The Nalco System.
— Nalco Laboratories Photo

Nalco

SERVICES AND PRODUCTS

- A Nalco SURVEY provides a complete water treatment picture, with recommendations if necessary.
- LABORATORY RESEARCH keeps modern chemicals and water treatment methods at work *for you.*
- PRODUCTS recommended by Nalco are designed to deliver full water treating value, in the forms best suited to your plant requirements.
- PLANT SERVICE by thoroughly experienced water treatment engineers... Keeps The Nalco System up-to-the-minute in your plant.
- TEST EQUIPMENT furnished by Nalco makes routine tests and control procedure fast and accurate.
- THE NEW NALCO SR SERIES OF PRODUCTS alleviate fire side deposits.

WHAT IS GOOD WATER TREATMENT?

WE CAN all agree that *good* water treatment should provide clean pipe lines from the raw water intake through all equipment and including condensate return lines. It should provide clean valves, cooling systems, turbines, and boiler and processing equipment free from scale, corrosion, slime and algae. Boilers should be maintained free from foam so that steam can be produced in a satisfactorily dry condition with blowdown kept at a minimum. Such a condition should be maintained on a permanent basis with a *good* system of water treatment.

This, briefly, is the Nalco idea of *good* water treatment. It is the kind of water treatment that is possible and has proven economical in thousands of plants now using The Nalco System.

For your own satisfaction, and at no obligation whatever, ask to have a Nalco field representative survey your plant so that you may decide for yourself the benefits The Nalco System has to offer.

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6222 West 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem, Limited, Burlington, Ontario

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How to plan a

COOLING TOWER WATER SYSTEM FOR MULTIPLE STORY BUILDINGS

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

In areas where water costs are high, or water consumption is restricted by local ordinances, users of large quantities of water for cooling purposes must provide for its reuse. The system shown here is recommended for installation in multiple story buildings where cooling water is required on several floors, and each tenant has an individually controlled air conditioning system. It is also applicable in industrial buildings where condensers, heat exchangers, coolers and other pieces of apparatus are located on different floors.

After water is cooled in the tower, it is discharged into the downcomer which feeds all cooling equipment. The used water, now slightly heated, drains into a common vented hot well and is returned to the cooling tower for a repetition of the cycle. The pump returning the water must be of sufficient capacity to handle the maximum flow through all equipment simultaneously. However, since the flow into the hot well can vary from that maximum to practically no flow, it is necessary to control the flow from the tank to avoid excessive starting and stopping of the pump. In this system, the regulation is accomplished by two float controls. One float starts the pump at high water level and stops it at low water level. The second float controls a regulating valve in the pump discharge so that the flow from the hot well decreases as the water level in the tank lowers. This method reduces the number of starts and stops of the discharge pump, adding to its efficiency and service life.

In buildings 15 stories or over, it may be necessary to place pressure reducing valves on the downcomer in order to keep pressure of flow entering cooling equipment at a safe level. It also may be more economical to sectionalize the building and maintain a pumping station and hot well for a specified number of floors. If this is done, separate downcomers are required for each group of floors, with either individual cooling towers or sectionalized pans in the main cooling tower.

Consultation with accredited piping engineers is recommended when adapting these suggestions to your own requirements, or when planning any major piping installation.

Copies of Layout No. 43 will be furnished on request. Just fill out and mail the coupon.

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A Use the right type valve for the service.
B Place valves correctly in the line.
C Choose Jenkins Valves for lifetime economy.

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Fig. 47
Solid Wedge—Inside Screw Traveling Spindle
BRONZE GATE VALVE
125 Pounds Steam
200 Pounds O.W.G.

Excellent where full, free flow is required. The traveling spindle indicates position of wedge and lifts it entirely clear of line of flow when valve is fully open.

A CHOICE OF OVER 500 VALVES

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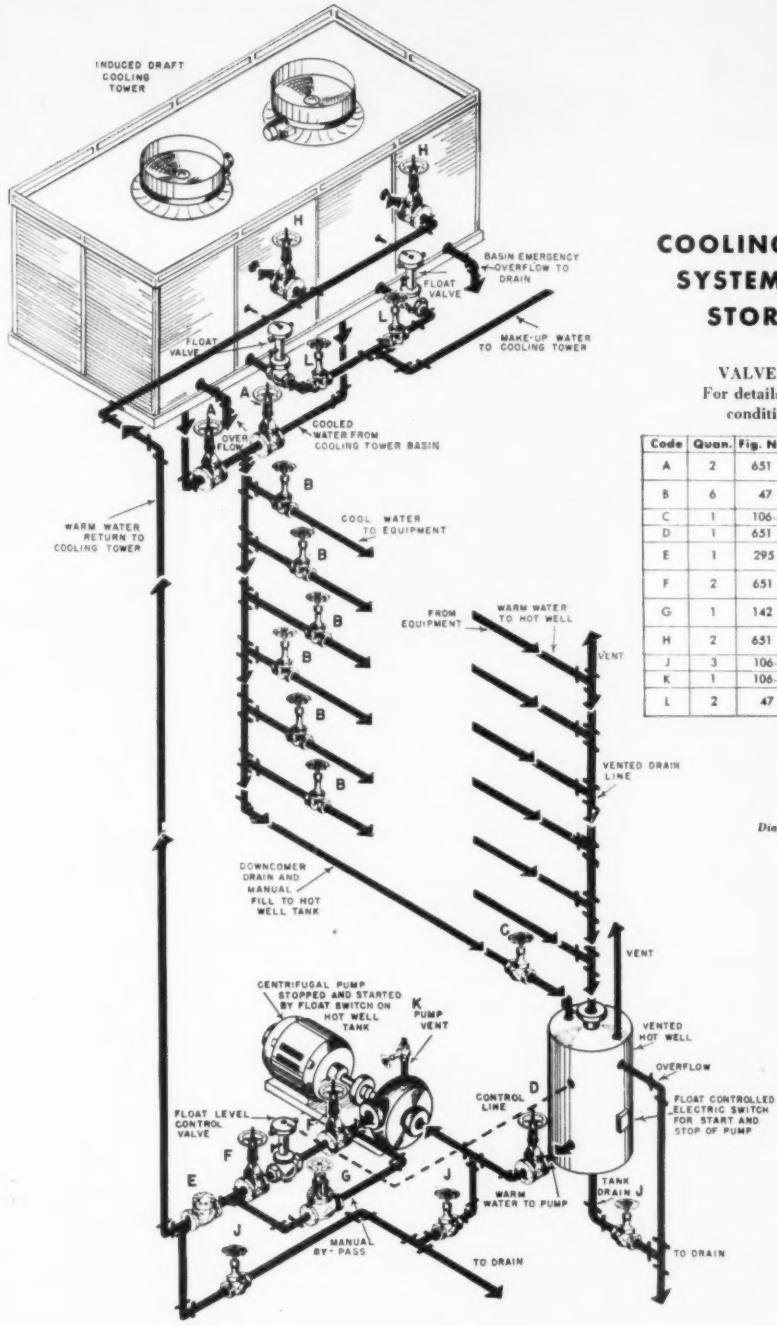

COOLING TOWER WATER SYSTEM FOR MULTIPLE STORY BUILDINGS

VALVE RECOMMENDATIONS

For details and valves to suit varying conditions see Jenkins Catalog

Code	Quan.	Fig. No.	Type	Service
A	2	651	I.B.B.M. Gate	Cooled Water Discharge from Cooling Tower
B	6	47	Bronze Gate	Individual Floor Shutoffs
C	1	106-A	Bronze Globe	Downcomer drain
D	1	651	I.B.B.M. Gate	Pump Suction Shutoff
E	1	295	I.B.B.M. Check	Centrifugal Pump Discharge
F	2	651	I.B.B.M. Gate	Float Level Valve Shutoff
G	1	142	I.B.B.M. Globe	Float Level Valve Bypass Manual Control
H	2	651	I.B.B.M. Gate	Warm Water Return to Cooling Tower Shutoff
J	3	106-A	Bronze Globe	Drain Valves
K	1	106-A	Bronze Globe	Pump Air Vent
L	2	47	Bronze Gate	Make-up Water to Cooling Tower

Diagram by Huxley Madeheim Consulting Engineer

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POWER'S DATA SHEETS

Number 201

Hydro-Pneumatic Tank Storage

► POWER's September 1948 issue (pp 75-7) had a thorough discussion of the application and limitations of hydro-pneumatic tanks for water storage. Here's a graph by which actual available water storage can be figured for given pressures and different initial water levels. Necessary adjustments of these factors can be quickly made with the aid of this chart to realize the maximum storage possible.

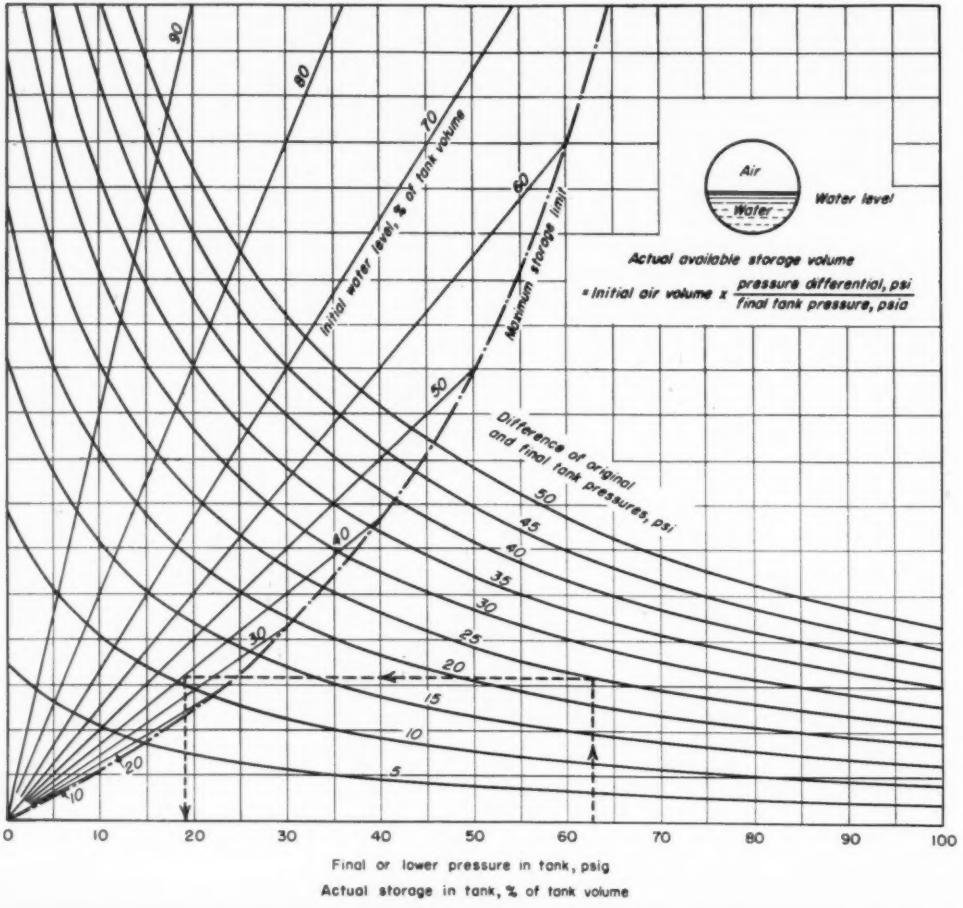
Example: A hydro-pneumatic tank has final pressure of 62.5 psig after discharging water that initially occupied 40% of tank volume at a pressure of 87.5 psig. How much tank volume was available as actual storage?

Pressure drop = 87.5 — 62.5 = 25 psi.

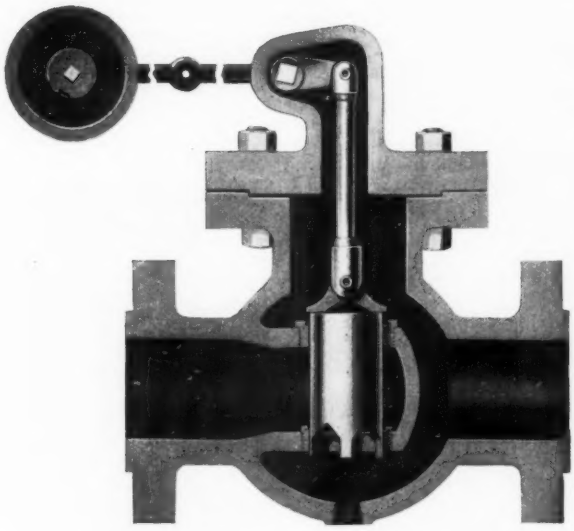
Find 62.5-psig final pressure on bottom scale, follow up trace to 25-psi pressure differential on curves, trace horizontally to 40% curve for initial water level, drop down vertically to horizontal scale to read 19.2% actual storage volume in the tank available.

Maximum storage-limit curve will show the initial volume setting for the given pressures to obtain maximum storage volume. For the example this would be 24.5%, found by dropping down vertically to the horizontal scale from the horizontal intercept. This also equals the original water level. In other words, the entire tank-water content becomes available storage.

—C A Giese, New Martinsville, W. Va.


Initial water level, % of tank volume
Maximum storage limit
Air
Water
Water level
Actual available storage volume
= Initial air volume x pressure differential, psi / final tank pressure, psia
Difference of original and final tank pressures, psi
Final or lower pressure in tank, psig
Actual storage in tank, % of tank volume

COPES BALANCED VALVES



A valve may be statically balanced while at rest, yet be so badly unbalanced dynamically—when handling flows under pressure—that inaccurate response to the actuating element causes a "hunting" action which makes impossible the desired precision of control. In COPES Valves, unbalanced forces are held within narrow limits over the entire operating range. This is why so many have been purchased *at a premium,* where control must be precise with actuation by float, solenoid or other element. Sizes: ¾-inch and up. When writing for data, give complete information on your operating needs.

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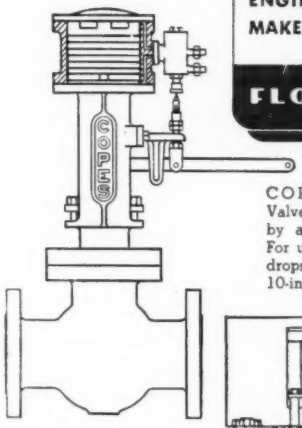
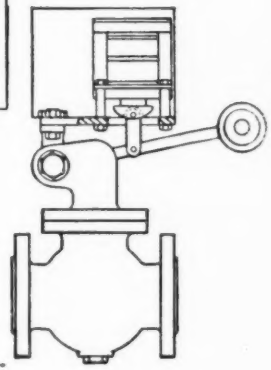


COPES Type SLH Valve, relay operated by air, oil or water. For unlimited pressure drops. Sizes: 1½- to 10-inch.



COPES Solenoid Valve has direct or tripper action. For pressure standards to 300-psi. Sizes: ¾- to 6-inch.

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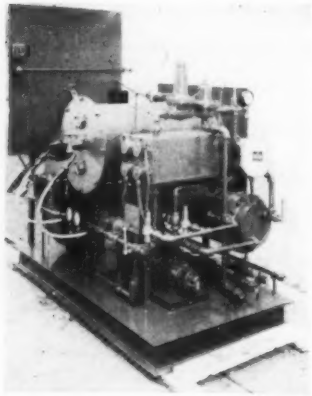
NEW PLANT EQUIPMENT



Oil Burner E163

COMPLETELY SELF-CONTAINED, packaged combustion system is available for automatic and semi-automatic control. A full system of fuel-oil pumping and preheating equipment, a forced-draft blower and a wide-range constant-differential mechanical-atomizing oil burner have been mounted on a steel base ready for bolting to boiler front.

Burner comes in sizes capable of firing boilers from 3500 lb per hr steaming capacity on up. Unit has dual gas-electric ignition system and requires no furnace checker floor work or secondary air lanes under furnace walls or floor. **Peabody Engrg Corp, 580 Fifth Ave, New York 19, N. Y.**

Armature Tester E218

THIS ELECTRONIC TEST UNIT consists essentially of two sections: a vacuum-tube oscillator that generates 3000-cycle ac voltage of about 15-v at no load and an electronic voltmeter section having an output impedance of 500,000 ohms through the vacuum-tube amplifier. Device is equipped with lightweight test prods that can be adjusted for various commutators, and a cathode ray or magic-eye indicator mounted on test prods to facilitate rapid testing.

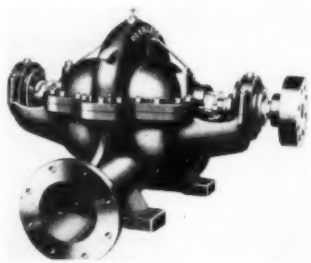
Although bar-to-bar tester is light in weight, it is designed for actual shop usage. It is not necessary to recalibrate the unit when the tube is replaced, nor does it require specially selected tubes for oscillator section. The unit weighs 23 lb and operates from a 110-v, 60-cycle ac power supply. **National Electric Coil Co, 794 Chambers Rd, Columbus 16, Ohio.**

Temperature Control E189

SELF-OPERATED rigid-stem-type temperature regulator limits flow of cooling water through engine and compressor jackets, hydraulic presses, vapor degreasers, condensers, etc, to maintain constant temperature. Closely balanced, double-seated valves provide accurate control without danger of sticking or chattering. A separable socket allows regulator to be removed for inspection without interrupting operation. It comes in sizes $\frac{3}{8}$ to $1\frac{1}{2}$ in. for water pressures up to 150 psi. **Sarco Co, 350 Fifth Ave, New York 1, N. Y.**

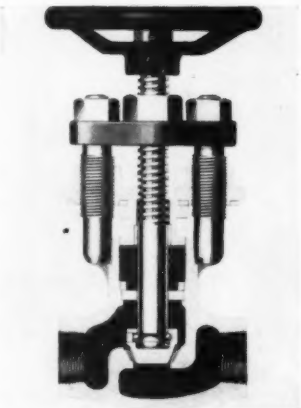
Thermometer E185

MODEL 918 thermometer employs a sensing element known as a resistor bulb, which is readily placed in tanks or other vessels, with the direct indicating instrument mounted any reasonable distance from bulb. With incorporation of a selector switch and multiple bulbs, a number of temperature measurements are possible with one indicating instrument. Indicator is a ratio-type instrument with a scale over five inches long, having excellent control and damping, and showing quick response to temperature variations. It is designed for use on 100-130 v, 50-60 cycles, ac, and is not affected by normal line-voltage variations. It can also be supplied for use on dc. **Weston Electrical Instrument Corp, 617 Frelinghuysen Ave, Newark 5, N. J.**



Centrifugal Pumps E177

CHARACTERIZED by a capacity range up to 60,000 gpm and 300-ft head, these horizontal-shaft centrifugal pumps are for general purpose pumping of water and alkaline fluids at temperatures up to 300 F. They are a single-stage double-suction split-case design in sizes of $1\frac{1}{4}$ to 48 in. Drives include direct-connected electric motors, diesels, gas and gasoline engines, steam turbines; also belt drives. They are regularly furnished in cast iron, but may be obtained in steel, bronze, or other alloys. Impellers are enclosed double-suction design normally built of bronze, but available in cast iron, stainless steel, monel and other alloys. Impeller wearing rings, casing wearing rings, and shaft sleeves are used. Pumps have grease-lubricated ball bearings, except in 30-in. size and above, which have babbitt sleeve bearings and ball thrust bearings. **Peerless Pump Div, Food Machinery and Chemical Corp, Los Angeles 31, Calif., or Indianapolis, Ind.**



Valve Seat E186

HANCOCK SERIES 60 globe and angle *Weldvalves*, 2 in. and smaller, are now fitted with integral stellite seats. By providing seating surfaces of superhard stellite, integral with the valve body, need for seat replacement is completely eliminated. With addition of the *Series* 60, all *Hancock* steel *Weldvalves*, gate, globe and angle, 2 in. and smaller, will now be furnished with integral stellite seats as standard production at standard prices. **Manning, Maxwell & Moore, Inc, Watertown 72, Mass.**

Liquid-Level Control E192

TYPE X PROB-O-TROL floatless control may be used wherever control of liquids is desired. It may be used to sound alarms, to indicate liquid level, to detect an increase of flow of liquids in pipes or to control pump or valve operation. Device is for service with electrically conductive material where corrosive conditions or sanitary regulations prohibit use of other types of level controls. On-the-job setting prevents action with saturated vapor or foam, as steam or beer, unless such operation is desired.

Unit is a tubeless ac control, combining a probe circuit and transformer to operate

Use convenient reply cards on page 196a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

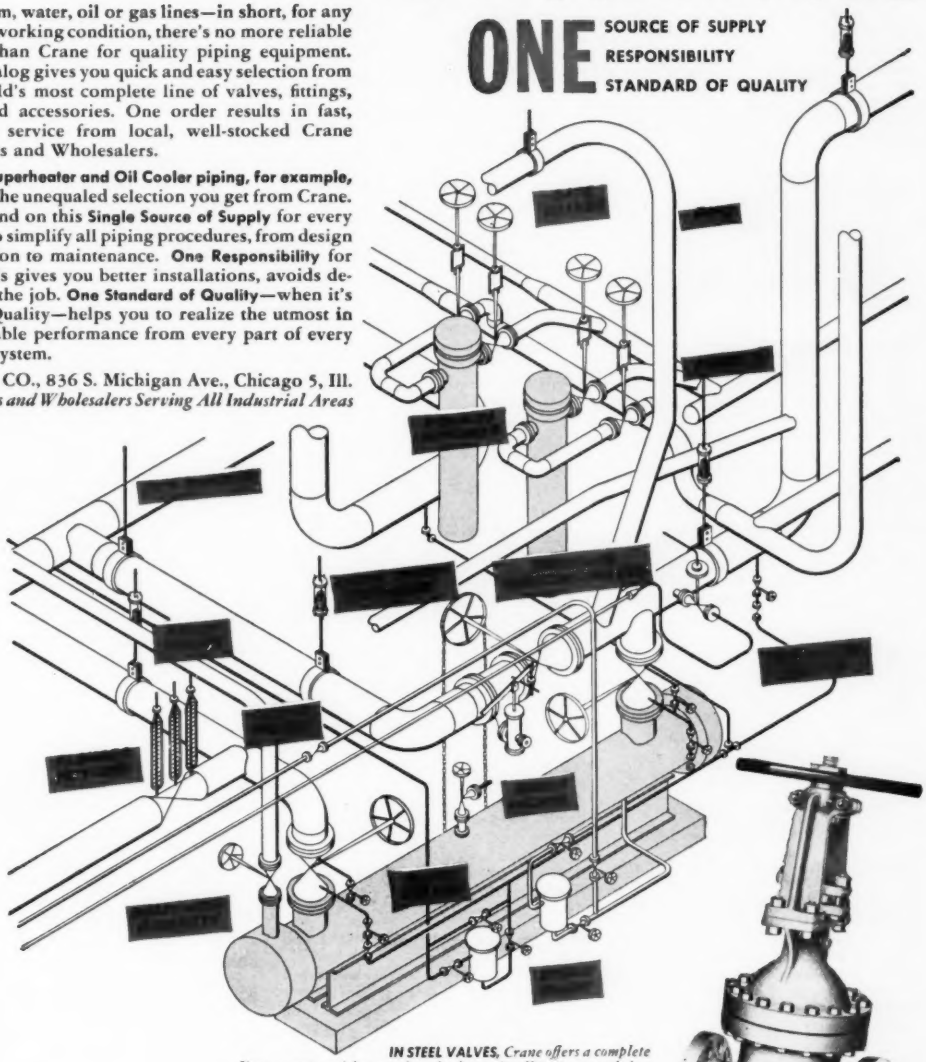
It's CRANE for complete selection for any power piping

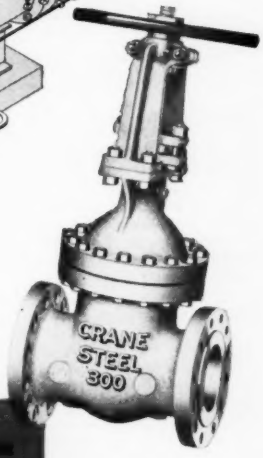
For steam, water, oil or gas lines—in short, for any fluid or working condition, there's no more reliable source than Crane for quality piping equipment. One catalog gives you quick and easy selection from the world's most complete line of valves, fittings, pipe and accessories. One order results in fast, modern service from local, well-stocked Crane Branches and Wholesalers.

This Desuperheater and Oil Cooler piping, for example, typifies the unequaled selection you get from Crane. To depend on this **Single Source of Supply** for every item is to simplify all piping procedures, from design to erection to maintenance. **One Responsibility** for materials gives you better installations, avoids delays on the job. **One Standard of Quality**—when it's Crane Quality—helps you to realize the utmost in dependable performance from every part of every piping system.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

ONE SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY





IN STEEL VALVES, *Crane offers a complete line . . . gates, globes, angles, checks . . . in all patterns and sizes . . . in pressure classes from 150 to 1500 pounds. Shown here, Crane No. 33X 300-pound Cast Steel Wedge Gate, trimmed to handle temperatures up to 900 deg. F. Flanged, screwed or welding ends. See your Crane Catalog, p. 304.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

NEW EQUIPMENT CONTINUED

a dc relay through a rectifier. Type *X* provides both a differential level control or specific level operation in a single unit. Operates on 115 or 230 v, 25 to 60 cycles, ac, and may be mounted as desired up to 100 ft from probe site. **Automatic Control Co, 1005 University Ave, St. Paul 4, Minn.**

Flame-Failure Device E158

SEMI-AUTOMATIC and manually ignited industrial fuel-oil burners can have flame-failure protection with *Fireye System FF-3*. Unit consists of two major elements—a photoelectric scanner and a control.

The scanner, housed in a dust-tight aluminum box, contains a phototube and a vacuum-tube amplifier. It mounts on the burner mounting plate for a clear view of the fire. When flame fails it signals the control, which, in turn, cuts off fuel supply and sounds an alarm. **Combustion Control Corp, 77 Broadway, Cambridge 42, Mass.**

Weld Clamp E170

RIGHT-ANGLE KORNER-KLAMP, of all metal construction, has an adjustable screw fitting that allows securing at the correct 90-deg angle any two pieces whether they are of the same thickness or not. Maximum thickness is $\frac{5}{8}$ in. **Thermocote Mfg Co, 420 S San Pedro St, Los Angeles 13, Calif.**

Selenium Rectifier E216

PROTECTIVE finish for selenium rectifier stack makes it moistureproof and capable of withstanding salt spray for periods up to 200 hr. It is recommended for service under adverse atmospheric conditions, such as high humidity, tropical climates, corrosive fumes, etc.

Unit is available to supply dc power at 2 v and 150 ma to 5000 v and 10,000 amp (and above). In general, efficiencies vary between 65 and 85%, depending upon circuit employed. **International Rectifier Corp, 6809 S Victoria Ave, Los Angeles 43, Calif.**

Three-Phase Transformer E206

INCORPORATING all protective devices of the *CSP* single-phase distribution transformer, these new units have built-in de-ion lightning arresters, three mechanically interlocked heavy-duty circuit breakers on the secondary side as safeguard against overloads and short circuits while primary protective links supply system protection.

Transformers are available in 9, 15, 30, 45 and 75 kva for primary voltages of 2400 to 14,400 v inclusive and with secondary voltages of 208Y/120, 240 v delta. Transformers are equipped for pole mounting or they can be mounted on platforms or mats as required. **Westinghouse Electric Corp, 306 Fourth Ave, Pittsburgh 30, Pa.**

Shaft Pillow Block E200

CONTAINING a self-aligning ball bearing and new oil-resistant seal, pillow block and its companion flanged cartridge are available for service with shafts of $\frac{1}{2}$ to $1\frac{1}{4}$ in. dia.

Inner race is locked to shaft by two knurled cup-point setscrews set at 120 deg. Bearing is prelubricated and may be placed directly in service; pressure fitting simplifies regreasing. **Boston Gear Works, Quincy 71, Mass.**

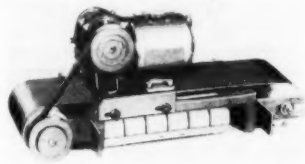
Vacuum-Tube Voltmeter E212

DESIGNATED AS TYPE AA-1, this instrument has a calibrated range of 1 mv to 300 v at frequencies between 10 cycles and 1.5 megacycles. It also is graduated in decibels, covering range between −52 and +52 decibels from reference level of 1 milliwatt at 600 ohms.

Instrument is designed for measuring voltage in electronic and other low-energy circuits where minimum current drain is desirable. It is suitable for either portable or bench use. Six ft of rubber insulated cord is provided for connecting unit to a 115-v supply circuit. **General Electric Co, Schenectady 5, N. Y.**

Venting Valve E175

HIGH-PRESSURE AIR VENT provides rapid and continuous escape of air while closing tight against both steam and hot or cold condensate. *Speedyvent* comes in four standard models to handle pressures up to 600 psig. **Livingstone Engineering Co, 100 Grove St, Worcester 5, Mass.**



Magnetic Separator E178

PERMANENT MAGNET UNIT automatically protects crushers, grinders, pulverizers, stokers, and other equipment from tramp-iron damage. It also removes contaminating iron from grain, liquids, sand, coal, rubber, chemicals and similar materials, and prevents fires and explosions caused by tramp-iron sparks in dust-laden atmospheres. It is designed to be installed over conveyor belts, spouts, or chutes.

The unit consists of a heavy permanent magnet and a motor-driven endless cross belt. A powerful permanent magnet attracts and holds tramp iron to the under side of the cross belt, which carries it beyond influence of magnetic field where it drops. This self-cleaning plate is equally effective with wet or dry material and the magnet can be submerged. Units are available in sizes to meet any requirement. **Dings Magnetic Separator Co, 4740 McGeogh Ave, Milwaukee, Wis.**

Soldering Iron E193

REQUIRING NO ELECTRIC CURRENT or external heat of any kind, *Quik-Shot* soldering iron uses a chemical cartridge that heats the iron to working temperature in 5 sec. It maintains the iron at an average soldering temperature of 800 F for seven minutes. Cartridge is ignited by the impact of a spring rod, which is pulled out and released at the back of the handle. Chemical mixtures used in the cartridge consist of a magnesium-type powder capable of generating intense heat. Heating action is according to the "thermit" process, whereby heat but no gas is generated. Manufac-

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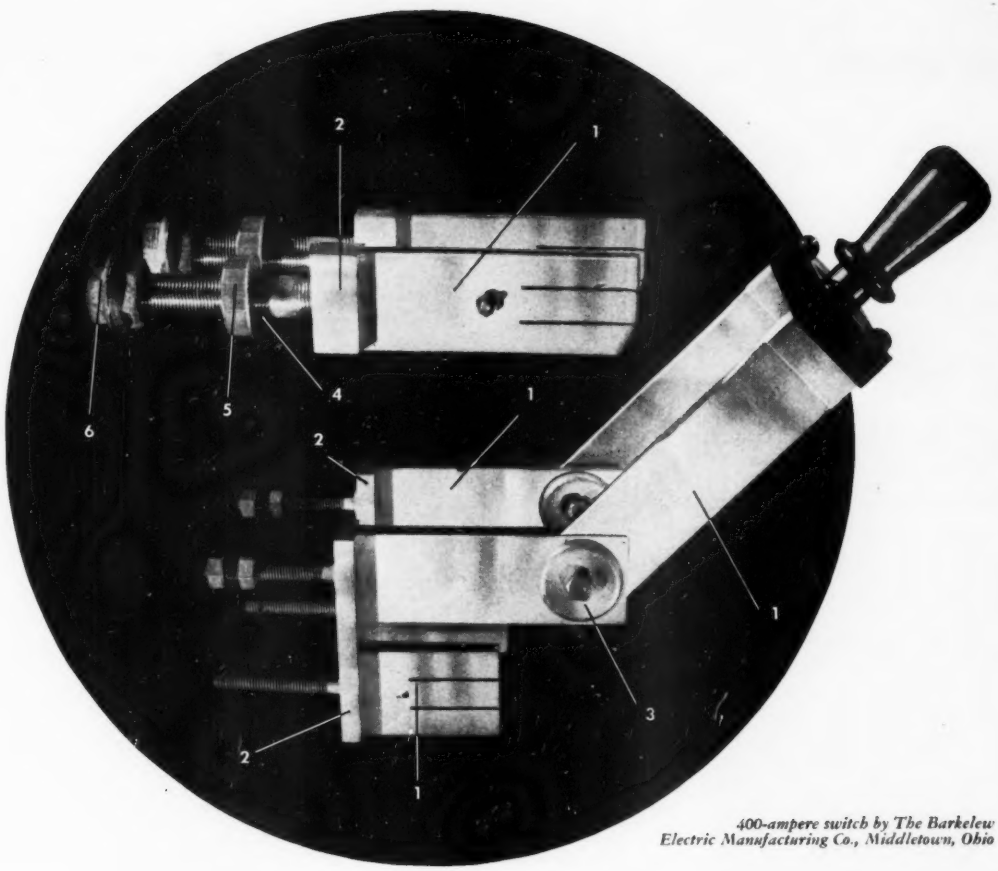


400-ampere switch by The Barkelew Electric Manufacturing Co., Middletown, Ohio

WIDE VARIETY OF REVERE METALS PERMITS EXACT SPECIFICATION TO MEET CONDITIONS OF USE

Note the number of different Revere Metals used by Barkelew in this switch, in order to assure low losses, reliability, accuracy, long life and economical manufacture.

1. *Electrolytic Copper.* For full conductivity.
2. *Free-Cutting Copper.* For quick, economical, trouble-free machining; in this case, producing sharp, clean, accurate slots and tapped holes in the copper base blocks. Free-cutting copper is rated in excess of 70% machinability of free-cutting brass, depending on type of operation.
3. *Herculoy.* Has the strength of mild steel, the corrosion-resistance of copper. The Herculoy washers in this switch assure permanence of pressure.
4. *Brass.* Washers, stamped out of sheet.
5. *Free-Cutting Brass.* Nuts, machined from free-cutting rod.
6. *Cast Electrolytic Copper.* For nuts not presenting machining problems.

Materials were very carefully chosen in designing this switch. For example, the hinge block for the high clip must have two slots milled in it to receive the clip leaves; Revere Free-Cutting Copper was selected for its superior machining characteristics. Slots in the lower hinge blocks are sawed all the way through, and here Revere Hard Drawn Electrolytic Copper is suitable.

Revere will gladly cooperate with you in working out the most advantageous application of metals to your products. Revere Metals are: Copper and Copper Alloys, Aluminum Alloys, Electric Welded Steel Tube.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

turer claims the cartridge to be entirely safe in all respects. It is especially adapted to all kinds of outdoor work, or indoors where electrical outlets are not easily available. Six interchangeable tip sizes are available, ranging from ⅜ to 1⅛ in. **Kemode Mfg Co, 161 West 18th St, New York 11, N. Y.**

Bearing Bronze E169

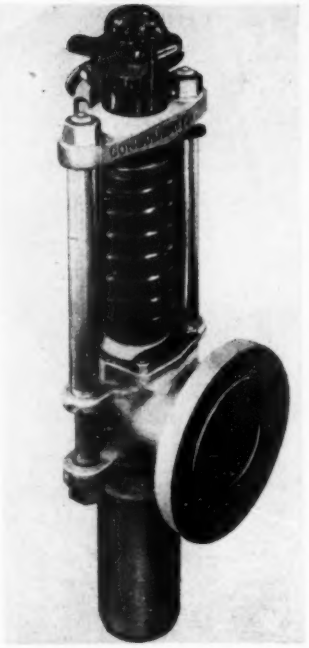
DENSE, small-grained continuous cast bearing bronze is being marketed under the trade name of *Asarcon* 773 in standard sizes ranging from ½ in. dia up to 4¼ in. in solids, and 1 in. OD by ½ in. ID to 4¼ in. OD by 3¼ in. ID in hollow bars. **Ampco Metal, Inc, 1745 S 38th St, Milwaukee 4, Wis.**

Grease Remover E164

NONINFLAMMABLE, nontoxic detergent softens and washes away greases and, in addition, leaves behind a film that prevents corrosion. Depending on weight of oils or greases to be removed, *Aqua-Turge* may be diluted with 10 to 64 parts of water. **Brooks Boiler Treatment Co, 3304 E 87th St, Cleveland, Ohio.**

Dc-Power Supply E214

PORTABLE rectifier power-supply unit provides mobile, flexible source of testing power for 12- and 24-v dc motors and controls. Designated as *PEC* 272, this caster-mounted unit operates directly from line at usual voltages. Power unit operates at ambient temperatures not exceeding 40 C and under normal atmospheric conditions. **Power Equipment Co, 55 Antoinette St, Detroit 2, Mich.**



Safety Valve E187

MAXIFLOW SAFETY VALVE is designed and engineered to meet operating requirements of high-pressure high-temperature steam-generating equipment. Valve functions with a blowdown as low as 1%, and features *Thermodisc* seat, and through-bushing design. Latter eliminates any difficulties because of porous body casting. Pressure medium is completely isolated from body casting and is contained within a corrosion-resistant stainless-steel forging. The through bushing, with its machined surfaces, provides optimum entrance conditions for steam flow. It is readily replaced without expensive delays because of chipping out welded joints and rewelding. **Manning, Maxwell & Moore, Inc, 11 Elias St, Bridgeport 2, Conn.**

Magnetic Pulley E176

PERMANENT-MAGNETIC PULLEY removes tramp iron from raw or processed materials and protects grinders, pulverizers, and similar equipment from such iron. It has uniformly high magnet strength across face of pulley. Because it has no wiring or other electrical connections, the pulley can operate under all atmospheric and temperature conditions. It is made in more than 50 sizes, from 12 in. in diameter by 12 in. wide to 30 in. in diameter by 60 in. wide. **Stearns Magnetic Mfg Co, Milwaukee 4, Wis.**

Installation Stripper E213

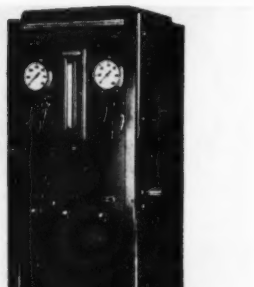
By SQUEEZING handles of the *Stripmaster*, device grips wire, cuts insulation, and then strips the wire, all in one operation. As handles are released, the grippers automatically free the wire and jaws return ready for next cut. Possibility of nicking or cutting the wire is eliminated.

Unit is designed for stripping building fixture, or telephone wire, in addition to lamp and portable equipment cord. Four models handle all wire gages from No. 22 to 8. **Ideal Industries, Inc, 1025 Park Ave, Sycamore, Ill.**

Battery Charger E215

CHARGETTE is designed for servicing motorized hand lift truck batteries. In operation, the charging current is controlled through the charge rate prescribed by battery manufacturer: charge is shut down completely when battery is fully charged.

Each part of charger is readily accessible for inspection and maintenance. Brushes and generator field rheostat can be reached by removing the helmet-type motor-generator cover. Device is available in seven ratings handling both lead acid and Edison storage cells. **Electric Products Co, 1725 Clarkstone Rd, Cleveland 12, Ohio.**



Chlorinator E184

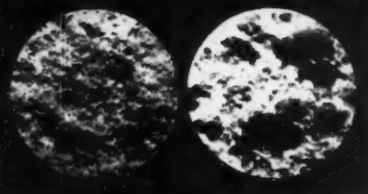
RATO-CHLOR is a dry-vacuum chlorine dispenser. Chlorine from a cylinder, drum or tank car is filtered and then delivered to the *Rato-Chlor* unit at a controlled pressure of -20 in. of water. Flow rate is set by adjusting a packless, needle-type regulating valve and is measured accurately by a *Flowrator* meter, calibrated to in-

(*Continued on page* 154)

Use convenient reply cards on page 196a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

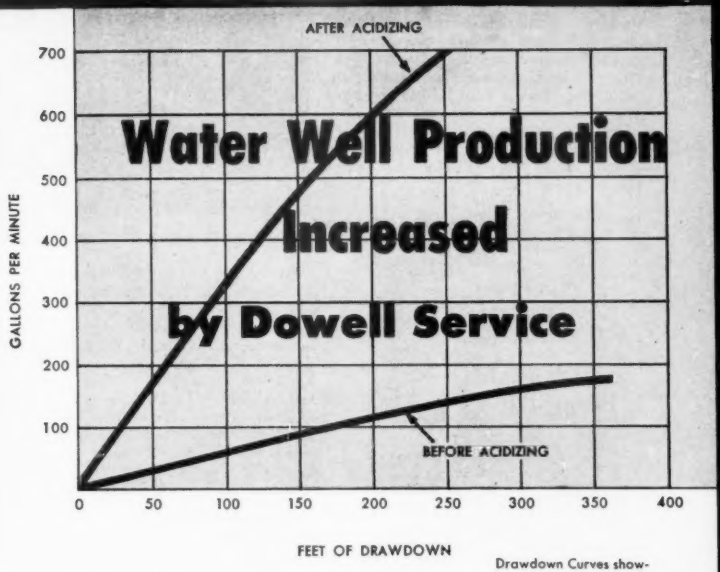
DOWELL

SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS



Acidizing of the limestone core above produced the enlarged passages shown in the right hand photograph.

The photographs below, taken with a subsurface camera, show the screen in a gravel-packed well before and after acidizing.



Drawdown Curves showing the advantages which have been obtained from proper chemical treating of water wells.

Scale incrustations and corrosion products on the well screen, pump, tubing and face of the producing formation will cut down the output of your water well. Dowell Acidizing Service is designed to remove these water-stealing deposits easily and quickly. Also, production may be increased due to enlargement of the water passages in the formation itself.

Case histories of many Dowell serviced wells show excellent results. For example, in a 1900 foot deep water well, calcium carbonate and iron oxide incrustations on the slotted liner had cut production to 65 g.p.m. After Dowell service, the well produced 632 g.p.m.—*an 872% increase.*

Dowell Acidizing Service requires a minimum amount of mechanical work since pulling of the pump or the screen is usually unnecessary. Experienced Dowell engineers do the entire treatment—using mobile equipment, they bring the proper solvents to the well site along with all necessary pumps, mixers and control equipment. Your nearest Dowell office will be glad to give you complete information and free cost estimates.

CALL

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

New York 20, Boston 16, Philadelphia 2, Baltimore 18, Wilmington 99, Richmond 19, Jacksonville, Atlanta, Buffalo 2, Cleveland 13, Pittsburgh 19, Detroit 2, Chicago 2, St. Louis 8, Indianapolis, Louisville, Kansas City 8, Wichita 2, Oklahoma City 2, Houston 2, New Orleans 12, Ft. Worth 2, Shreveport 23, Anniston, Alabama, Mt. Pleasant, Mich., Hamilton, Ohio, Charleston 27, W. Va., Salem, Illinois, Borger, Texas, Midland, Texas, Wichita Falls, Texas, Lafayette, La.

Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

A [illegible] ORGANIZATION

dicate pounds of chlorine vapor per day. A differential-pressure regulating valve completes flow-control element that maintains preset rate of flow constant.

Vacuum is created by an ejector and kept uniform by a regulating valve. The ejector also mixes a dilute chlorine-water solution which it discharges through a distributor, into the stream being chlorinated.

The *Flowrator* meter can be equipped with recording or totalizing devices to produce a continuous record of chlorine consumption and eliminate use of weigh scales. Machines come in 17 standard sizes ranging from a minimum capacity of 10 lb per day to a maximum of 7500 lb per day. Minimum capacity is one-tenth of maximum. Larger sizes and wider ratios of minimums to maximum capacity are available on special order. **Fischer & Porter Co, Hatboro, Pa.**

Arc Stabilizer E152

NEW CIRCUIT incorporated into the *Missing-Link* automatic arc stabilizer is said to reduce most radio interference resulting from high-frequency welding. The new circuit and control cuts off operation as soon as welding arc is broken. A finger-tip switch mounted on electrode holder is flicked on to resume operation. Elimination of idling, the manufacturer claims, gives cooler longer-wearing spark gap points as well as a reduction in radio interference. **Mid-States Equipment Corp, 2429 S Michigan Ave, Chicago 16, Ill.**

Elevator Buckets E175

FOR HANDLING powdered-fine, free-flowing materials, this elevator bucket is designed for high-speed service. Buckets may be mounted at intervals or continuously, depending on the capacity required, and may replace old-style buckets on existing elevators. They are spot welded and have a crimped back to insure rigidity and to provide smooth, flat surface for elevator belt contact. Tapered ends of buckets decrease pick-up load drag. Formed, overlapping ends provide smooth surfaces and strengthen the buckets. Size range from 3x3 in. to 24x7 in. **Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.**

Aluminum Welding E161

JOINING THIN ALUMINUM without warping or distorting surfaces can now be done with *Eutectrod* 900X. Used with a low-heat *Eutector Flux* 900X, welding alloy supplants brazing and fusion welding. It bonds at 900 F and remelts at 950 F. It has a tensile strength of 30,000 psi. The new welding rod is available in 3/64 and 1/32 in. sizes in coil form. **Eutectic Welding Alloys Corp, 40 Worth St, New York 13, N. Y.**

Demand Register E205

HAVING FEWER PARTS than previous designs, this new register is available in two models; indicating type, *M*-30, and cumulative type, *M*-31. They are designed for service by electric utilities, industrial plants and commercial establishments having comparatively small loads.

Both types make use of a *Geneva* mechanism for interval resetting operation. This enables timing motor to reset pointer pusher by direct-drive gearing without shock, eliminating need for spring and latch mechanisms found in conventional demand registers. **General Electric Co, Schenectady 5, N. Y.**

Magnetic Strain Gage E201

THIS DEVICE provides a simple method of directly measuring small distortion in a static member, which may result from a tensile or compressive load. For example, it serves as a warning to operator when crane is in danger of upsetting because of overloading. It may also be used on other metal structures where variation in load approaches the set safety limits.

Gage is enclosed in a watertight case measuring 3½x8¼x3¼ in. Pilot bar used with gage is sensitive to forces as low as 20 lb. Indicating dial may be located near the operator. Device is operated from a single-phase, 110-v, 60-cycle supply. Power required is 35 va. **Westinghouse Electric Corp, 306 Fourth Ave, Pittsburgh 30, Pa.**

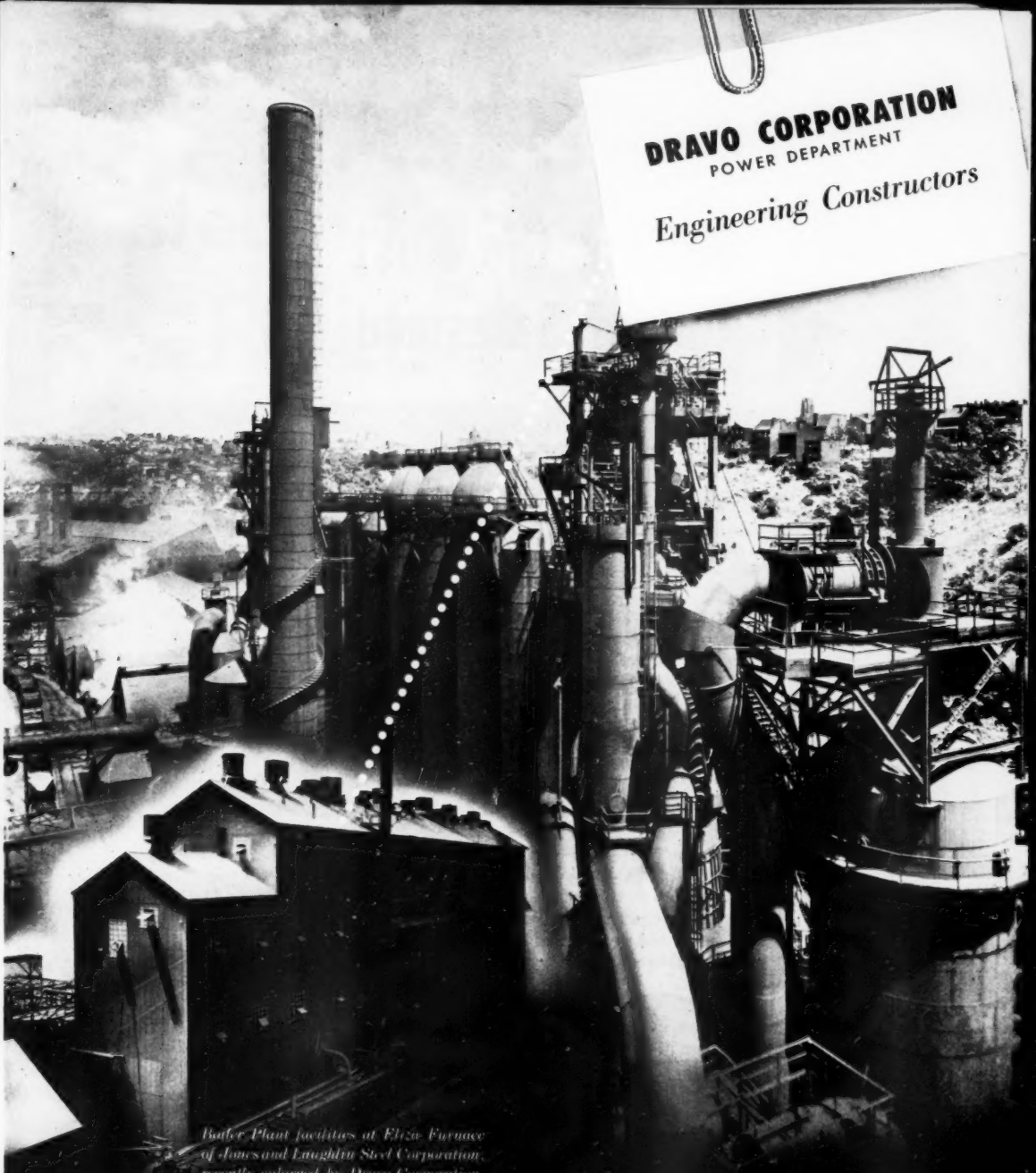
Steam Trap E188

NO. 118 STEAM TRAP was developed for small-drainage, light condensate-load jobs. It is particularly suitable for service with unit heaters, pipe coils, steam tables, kettles and laundry presses and ironers. Unit may be installed either as an elbow or straight-in-line without extra fittings, as only one pipe nipple is required. A blow-down and test plug permit easy cleaning and testing. Unit is satisfactory for pressures up to 150 psi, and has a capacity of 700 lb per hr (continuous flow) at 20 psi. It is made in ½-in. pipe connection size. Trap No. 118 is an inverted-bucket type, made with castings of nickel semi-steel, bucket and guide tube of copper and bronze, and all working parts of heat-treated stainless steel. Trap may be inspected without removal from the line. It comes equipped with thermal air eliminators at slight extra cost.

Three other traps in the *Super-Silvertop* line have been improved recently—No. 110, 119, and 120. They now have the following capacity ratings of pounds per hour (con-

(Continued on page 180)

Use convenient reply cards on page 196a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.



DRAVO CORPORATION
POWER DEPARTMENT

Engineering Constructors

Boiler Plant facilities at Eliza Furnace of Jones and Laughlin Steel Corporation, recently enlarged by Dravo Corporation.

DRAVO
CORPORATION

DRAVO BUILDING, PITTSBURGH 22, PA.

Engineering Constructors of power plants, boiler plants, central stations, compressor stations, water pumping stations — fabricators and erectors of power piping — power and boiler plant equipment.

Pittsburgh, Philadelphia, Cleveland, New York, Detroit

Getting the Most Out of Salesmen

A fellow I know in New Jersey, who runs a pretty good-sized power plant, claims he's never let a salesman in his place, and he's proud of it. Says salesmen waste his time, that he never learns anything from them, and that they should all be called in off the road because he knows what to do and buy without a peddler to tell him.

He reminds me of the youngster of 14 Mark Twain tells about, whose father couldn't tell him anything. When the lad got to be 21, and realized there were a few things he *didn't* know, he remarked that he was surprised at how much the old man had learned in seven years. With my man, however, there's considerable doubt that he will ever get to be 21.

I don't know whether this New Jersey engineer is ever going to let salesmen in his plant so he can find out what he's missing, but almost all the power men I'm acquainted with do welcome visits from sales representatives. Reason is, of course, that a good salesman will put you on to a new piece of equipment or a different method that will save you real money.

Some years ago, a trap salesman showed me how to redo my heating-system hookup which, with the addition of a few traps, saved us about $500 per year. This was the first of many constructive helps I have gotten from sales people since then.

Another example came up the other day in talking to an engineer supervising a production line. He said a salesman had showed him how to repackage the product (asphalt tiles), and this new method will save them $80,000 this year. A feedwater-treatment salesman I know has been so successful in helping reduce boiler down-time in one plant that he's practically a member of the firm.

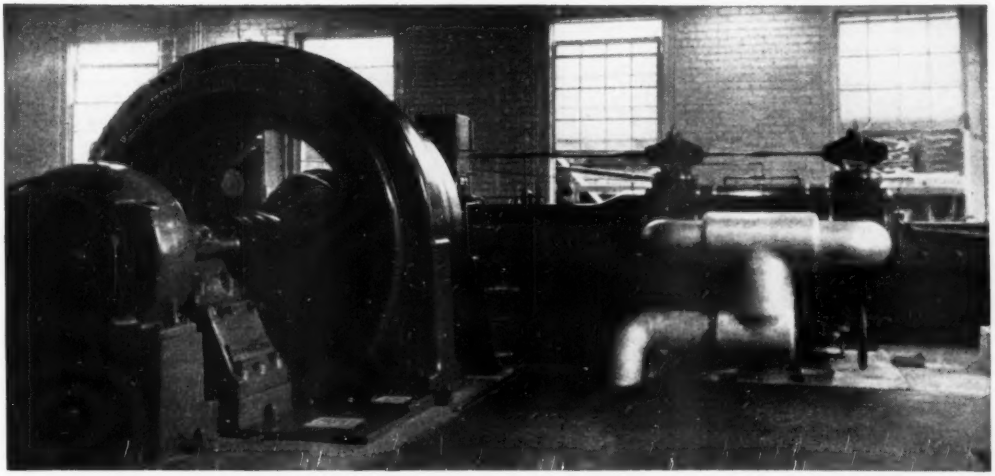
So it pays to listen to salesmen, and it also pays to screen them so you can separate the sheep from the goats. If you give them all a thorough hearing when they first call, it won't take you long to catalog them, so that you can give the best ones all the time they need to make their points. And there are many ways to ease the less helpful ones back out into the street. (If you've run out of methods on this one, let me know.)

A good way to treat salesmen is to select them the way most of us do our engineering magazines. Nobody can read them all—if we should try, we would never get any work done. So we pick out the best one or two—the ones that will help most in solving our particular plant problems—and let the rest go by.

Yes, there's an art to getting the most out of salesmen, but certainly it is not locking them all out of the plant. And though the temptation not to see them may be stronger today, now that competition has returned and the salesmen are out on the road seeking business again, give them a hearing. You may be surprised at the useful things some of them have learned in the past seven years.

George Edwards
Engineer

ASSURE
steam-tight rings for
FULL POWER



Lubricate new engines and old with Texaco steam cylinder oils

YOUR steam engines—whatever their type, size or age—will run at their best when lubricated with Texaco steam cylinder oils. There is a complete line of these fine oils to assure effective lubrication under all operating conditions.

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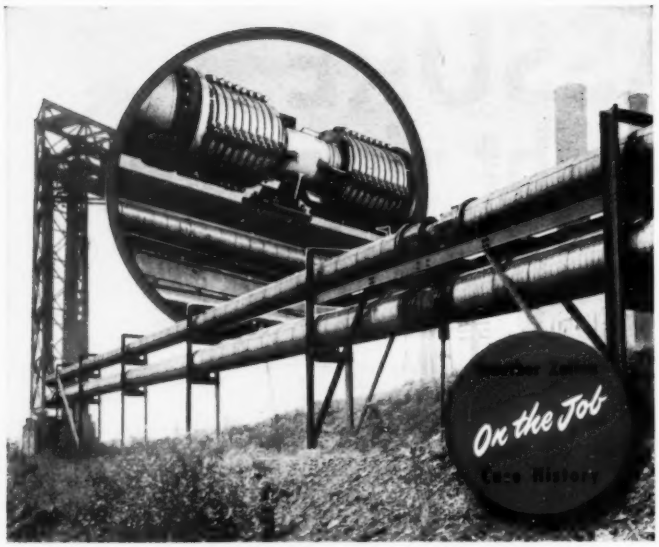
FOR EVERY STEAM CONDITION

Tune in . . . TEXACO STAR THEATRE every Wednesday night starring Milton Berle. See newspaper for time and station.



In a Word . . . DEPENDABLE!

HERE is one of several Zallea Stainless Steel Expansion Joints installed in the 250 lb. SWP 450° F. main steam distribution line of the Alan Wood Steel Co., Swedeland, Pa. . . . put there to assure uninterrupted production—and a continuous flow of steam to the mill. This installation is *another* vote of confidence for Zallea Stainless Steel Expansion Joints as the one ideal, *dependable* medium for absorbing movement in pipe lines due to thermal changes. Check these features to see why more and more engineers and designers insist on Zallea when they want the best:

- *More economical than expansion bends*—the cost of insulating and installing a bend alone is frequently more than the cost of a Zallea Stainless Steel Expansion Joint.
- *No maintenance*—having no packing they may be used in underground lines without manholes.
- *Low thrust against anchors*—require only 1/10 the force required to compress some slip type expansion joints.
- *An expansion joint for every type of service*—special types for combined axial and lateral movement.
- *Shorter face to face dimensions*—enables installation in close quarters.
- Hydraulic method of forming assures uniform wall thickness throughout corrugations.
- As easy to install as an ordinary flanged or welding fitting.
- Traverse range from fractions of an inch up to 7½" in a single unit and 15" in a double unit.
- Pressure range from vacuum to 300 lbs. in standard units. Up to 1000 lbs. in special units.
- Temperature range from sub-zero to 1600° F.

Catalog 47 contains complete information on all Zallea Expansion Joints. We would be pleased to send you a copy. Write today: Zallea Brothers, 814 Locust Street, Wilmington 99, Delaware.

Zallea
EXPANSION JOINTS

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

Electronics

(*Continued from page* 128)

If we shift the grid-voltage curve more out of phase with the anode voltage, as in Fig. 5*E*, the tube conducts for a still smaller part of the voltage wave. By the simple expedient of changing the phase relation between the grid and anode voltage the output current of the tube can be controlled from zero to maximum.

Phase-Shifting Grid Voltage. The grid voltage can be shifted by connecting a fixed resistor and an adjustable reactor in series and connecting them to a center section of the power transformer as in Fig. 6. Assume the main transformer primary and secondary volts in the direction indicated by the arrows on the windings. Then the load current flows from center tap *C* on the transformer through the load to the cathode and anode of tube *A*, and through the left-hand section of the secondary winding.

Another circuit exists from tap *D* on the transformer through resistance *R* and adjustable reactor *X* to tap *E*. If we assume that the impedance of reactor *X* is small compared to resistance *R*, then all current through *R* flows through *X*. Because of low impedance of *X*, primary current for the grid transformer *G* comes from *C* on the main transformer through the grid transformer primary and reactor *X* to *E*.

This puts a positive voltage on the grid of tube *A* and negative on the grid of tube *B* as indicated by the arrows. Since impedance of *X* has been made low the grid voltage will be nearly in phase with the anode volts, as in Fig. 5*B*. Then, tube *A* conducts during nearly the whole period of the voltage wave.

Increasing the inductance of *X* will throw the grid voltage out of phase with the anode volts as in Fig. 5*C* to 5*E*. The higher the inductance the more the grid voltage will be out of phase with the anode volts and the shorter the period that current will flow through the tube. The adjustable reactor may be a small coil with a movable iron core in it. As an example, moving a 2-oz core 1.5 in. in a coil is sufficient to shift the grid voltage from in-phase to nearly 180 deg out-of-phase with the anode volts, and thus control anode current from maximum to zero. There are several other ways of controlling the output current of thyratron, as with a saturable reactor or a peaking transformer, but the phase-shifting device, Fig. 6, has been used extensively.

Reversal of Ac Wave. On the reversal of the ac wave the circuits are

Prevent Water Hammer

with the "CUSHIONED CLOSING" of

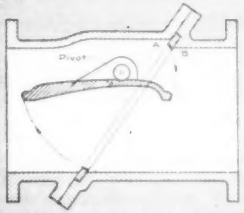
CHAPMAN

TILTING DISC CHECK VALVES

Chapman Tilting Disc Check Valves *work with . . . not against . . . the stream.* As a result, destructive pipe line stresses are practically eliminated. Head losses, as compared with conventional type check valves, are reduced 65% to 80%.

This balanced disc rides smoothly on the flow. It lifts away easily when opening . . . closes quickly and quietly. There is no rubbing on the seat . . . no slamming. Hinge pins, seats and bearings wear far longer.

These are facts. Write today for engineering data and reports of tests. Valves available in either iron or steel.



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The Chapman Valve Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

transformers stripped the old way
paint-stripping transformers in
half the time!
number of transformers stripped in same time the Oakite way

That's the record straight out of the files of a western New York utility company where the Oakite Hot Flow-On Method gave them more complete stripping, along with an important cut in stripping-time!

In addition to the important saving in time, this company was able to add substantial savings in stripping compound, because the Oakite Hot Flow-On technique recirculates for re-use potent Oakite stripping solution over and over again!

Hot Flow-On is only one of five time-saving Oakite stripping techniques. The Oakite "71" Digest describes in detail many worthwhile transformer paint-stripping methods. Here are five good reasons why you will want to ask your Oakite Technical Service Representative for a copy:

1. **Tells how fast-penetrating Oakite stripping compounds remove as many as 20 paint coats.**
2. **Tells how safe, easy-to-handle Oakite strippers run up amazing stripping-speed records.**
3. **Tells how economical Oakite *cold-spray* methods strip fast.**
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practically the same as in Fig. 6 except that the rectifying circuit is through tube *B*, Fig. 7. If inductance of reactor *X* is made low then current flows through *X* and *R* as indicated. It will also flow through *X* and the primary of grid transformer *G* through the load, tube *B* and back to the main transformer. This makes the grid plus in tube *B*, which permits current to flow through it. The instant at which the tube starts to conduct can be controlled by adjusting reactor *X*.

Returning to the grid circuits of Fig. 6 let us give them a little further study. On tube *A* grid, voltage is from tap *F* on the transformer to the cathode, through the tube to the grid, back to the transformer through resistance R_1.

In this case the grid acts as an anode and would conduct a comparatively high current if it were not for resistor R_1, which has several megohms resistance. When voltage is applied to the grid in a direction so it conducts electrons from the cathode we know the grid has positive polarity.

In tube *B*, voltage is applied to the grid in a direction that tends to cause current to flow from it to the cathode. Of course, this cannot occur but it would prevent the tube conducting even if the transformer's polarity were correct for current flow, which it is not.

Conditions in Fig. 6 are the reverse of those in Fig. 7. Here the grid in tube *B* has positive polarity the same as tube *A*, Fig. 6, and tube *A* grid, Fig. 7, is negative for the same reasons that the grid of tube *B* is negative, Fig. 6.

The rules we have applied here for grid polarity can be used anywhere, only be sure of the direction of the grid voltage.

Next article will discuss several designs of mercury-pool rectifiers.

Technical Briefs

(*Continued from page* 140)

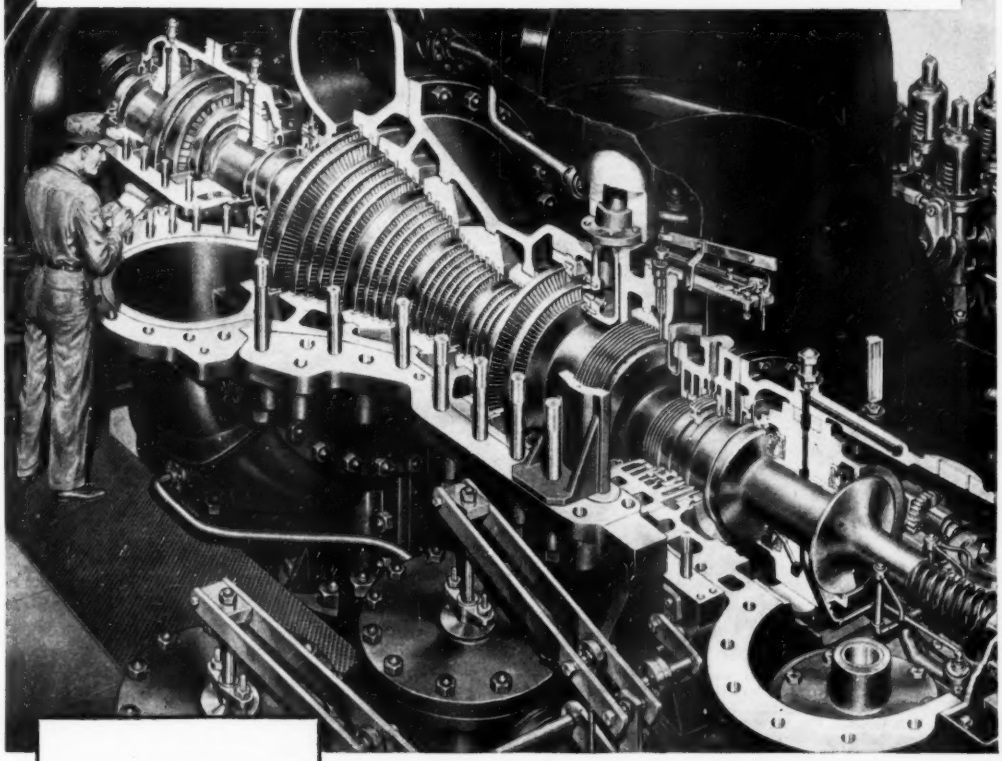
the press frame. The only pump then available was a variable-stroke ratio-piston type invented by Dr Hele-Shaw.

The heavy self-contained hydraulic press was developed in Great Britain about 1934. This lag of eight years behind the parallel development in the U. S. had its advantages because it allowed time to develop high-speed pumps for pressures of 6000 to 7000 psi.

The author suggests that for heavy self-contained hydraulic presses there is a considerable advantage in using a seated-valve pump for working pressures up to 7000 psi with a thin oil of 60 saybolt at 100 F. Compared with

635 TURBINES

Set Records with Gargoyle D.T.E. Oil 797



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Now it's in 635 turbines—Gargoyle D.T.E. Oil 797. And it's setting performance records undreamed of a few years ago. In seven years, not a single turbine taken out of service because of the condition of the oil. No appreciable change in the oil. But no wonder—this great product is made from a base stock that is in itself an excellent turbine oil with natural resistance to oxidation and foaming. To this stock, we've added still greater resistance to oxidation . . . and maximum protection against rust. It's one of the best, the safest turbine oil ever developed. Put it in your turbine now.

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present practices in the U. S., the following advantages are claimed:

1. Operates at twice the pressure of the hydraulic press. Cylinders are proportionately smaller.

2. Only half the volume of oil has to be moved.

3. Oil can be moved at four times the speed, 20 ft per sec instead of 5 ft per sec through the prefill valve.

4. It is possible to use smaller pipes and valves for the same pressing speed, or to operate at up to 8 times the speed with the same-sized pipes and valves.

5. The oil has a flat viscosity curve, so there is little variation of viscosity with changes of working temperature. There is no need for thermostatic control.

6. There is no need for air pressure to force the oil through the prefill valve into the press cylinder.

7. With the absence of pump "slip," there should be no need for cooling coils in a properly designed hydraulic system.

8. For the same reason (no slip) it is possible to control the pressing speed more accurately.

9. Pumps of this type have a longer working life, can stand serious overload, and they are not so easily damaged by the presence of grit and scale in the hydraulic oil. *ASME Paper No. 48-A-33.*

Kern Plant

(*Continued from page* 76)

wide range of outdoor temperatures in this region. The boiler firing aisle is housed but the steam generators and fans are outdoors with an umbrella roof over the steam generators.

The centralized control room features the station layout. This room places the operator close to the house turbine and feed pumps and within sight of the main turbine on one hand, and directly off the firing aisle on the other hand. Annunciators of a special signal system in the control room and throughout the station are mounted above the various control boards to show trouble points quickly.

Turbine-generators stand crosswise in the turbine room, parallel to each other with the throttles nearest the boiler room. This minimizes the length of high-pressure steam piping and requires only short generator leads to the transformers just beyond the station wall.

Machine shop adjacent to the turbine-room ground floor makes it accessible from the railroad track. Offices and laboratories are arranged along one wall of the auxiliary bay giving easy access to any part of the plant. Separate structures are provided for the storehouse, water-treat-

WHY SHOP FOR A BOILER??

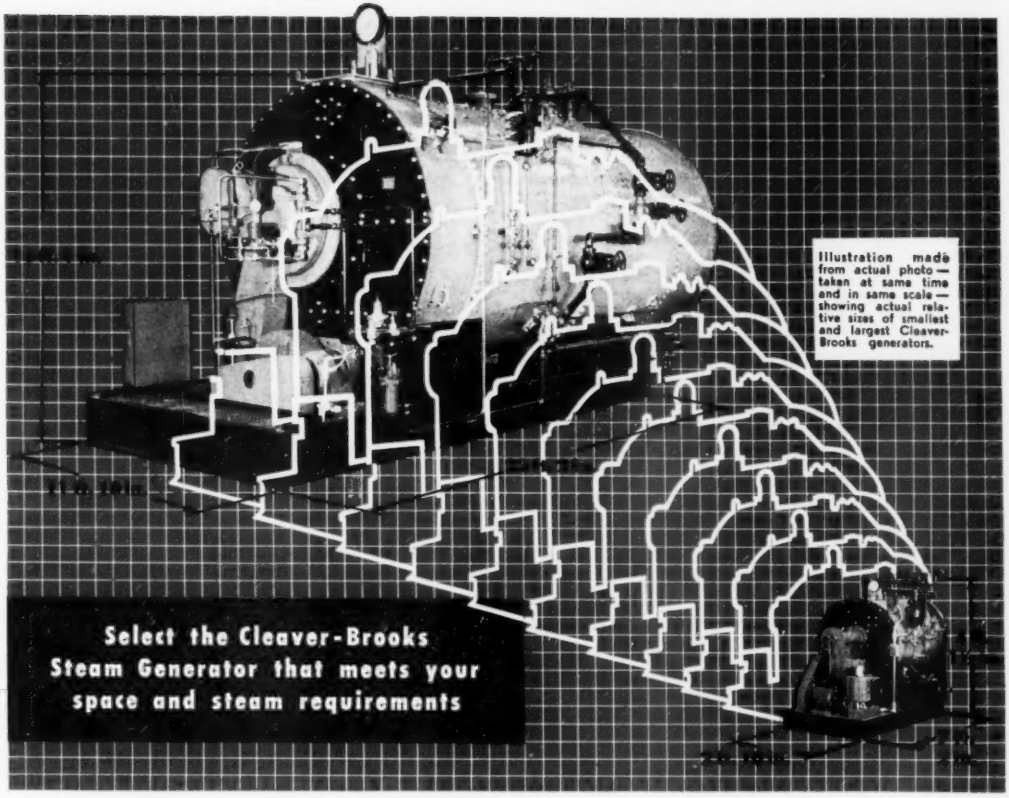
Illustration made from actual photo — taken at same time and in same scale — showing actual relative sizes of smallest and largest Cleaver-Brooks generators.
Select the Cleaver-Brooks Steam Generator that meets your space and steam requirements

WHY search and shop for a boiler — install a Cleaver-Brooks engineered and self-contained unit that fully meets your steam requirements and needs only a minimum of space and headroom.

You can select from a range of sizes 15 to 500 hp. — and you can have your Cleaver-Brooks boiler equipped for oil, gas, or with a combination burner which permits alternate use of gas or oil and provides for a quick change-over from one fuel to the other.

Equally important— you get Cleaver-Brooks guarantee of at least 80% efficiency from full load down to 30% of rating — with either gas or oil as fuel — and IN ALL SIZES.

Cleaver-Brooks steam boilers enable you to burn the available fuel in your area — give you clean, smokeless operation—eliminate fuel and ash handling — need no high or costly stacks — no special foundations — fit under low headroom and into limited space — provide flexible operation to meet fluctuating loads — fully meet all codes.

Oil or Gas Fired . . . Guaranteed 80% Efficiency from Full Load Down to 30% of Rating . . . IN ALL SIZES

Available in a size to fit your needs — 15 to 200 p.s.i., 15 to 500 hp.—write for Cleaver-Brooks Steam Boiler bulletin.

WRITE on your business letterhead for Free Steam Cost Calculator — a ready reference slide rule showing the comparative steam costs when using oil, gas or coal as fuel.

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BRONZE-TO-BRONZE SEATS... are extra-wide to give widest possible bearing surface. And each seat is precision-ground to lock the leaks.

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DART UNIONS

ing equipment and chlorinating apparatus.

Cooling towers for condenser circulating water and for bearing cooling water are placed to the northeast of the power-plant building and substations. In this position vapor from the cooling towers will have minimum objectionable effects on the plant with prevailing winds blowing.

Building is designed to resist earthquake shocks with a seismic factor of 0.2 G and including one-half of live loads.

Ventilation. Needs are based on maximum outdoor temperatures of 105-F dry bulb and 72-F wet bulb. Fans and ducts control air flow in the building. Air washers filter the air and provide some evaporative cooling. Air temperature leaving washers will be 77-F dry bulb and 72-F wet bulb. Air quantities are based on maximum temperature rise within building of 30 F.

All ventilation air goes directly from washers to turbine room, auxiliary bay, machine shop, firing aisle and to air-conditioning equipment for control room and fresh-air makeup for the office bay. Air exhausts through continuous ridge-type roof ventilators for the turbine bay, roof-type exhaust fans for the auxiliary bay and machine shop and propeller-type exhaust fans in the north wall of the firing aisle. The equipment operates at full capacity during the hot dry season, with ventilated sash kept closed to exclude all dust and prevent short circuiting of the ventilation system.

The control room is air conditioned with mechanical cooling to maintain temperatures of 83-F dry bulb and 50% relative humidity when auxiliary bay temperature is 95-F dry bulb. Fresh air comes from washers with no recirculation of conditioned air. Exhaust air discharges to the switchgear room, auxiliary bay and boiler firing aisle.

The office bay is air conditioned with mechanical cooling to maintain 85-F dry bulb and 38% relative humidity when auxiliary bay temperature is 95-F dry bulb. Fresh-air makeup comes from the washer with major portion of air recirculated. Partial exhaust goes through toilet-room exhaust fans.

Water Handling. Two wells, 30 ft apart in the northeast corner of the station property, supply all water. Each well has a capacity of 1500 gpm; No. 1 is 500 ft deep and No. 2 is 125 ft. Water from No. 1 has a pH of 7.9, hardness as $CaCO_3$ runs 75.5 ppm, and total solids at 105 C is 206 ppm, silica content is 49.2 ppm. Water from No. 2 has a pH of 7.4, hardness as $CaCO_3$ runs 98.0 ppm, total solids at 105 C is 98.0 ppm and silica content is 13.6 ppm.

Two main cooling towers for No. 1

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THIS EGYPTIAN FERRYMAN doesn't need boiler water treatment. There's no boiler scale on his biceps . . . no equipment to corrode . . . and as for carryover, he gets paid for that. • But these problems can be serious in plants powered by steam instead of sinews, or where water is used for process or cooling. That's why so many engineers depend on Bird-Archer's 8-Point Water Treatment Service. Backed by a half-century of experience, Bird-Archer has developed methods that effectively combat scale, corrosion and carryover . . . methods that keep operating costs DOWN and equipment efficiency UP. • For a profitable discussion of your water treatment problems, ask to have a Bird-Archer Field Engineer pay you a visit. There's no obligation.

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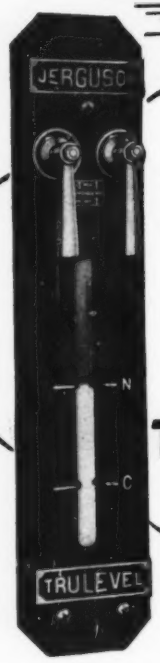

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YOU take water level reading out of the boiler room — and place it at the most convenient point for you — when you use Jerguson Trulevel Gages, for Trulevel gives complete accuracy at distant reading point.

Quick checking at distant reading point is another important feature of the Trulevel, and this is patented and exclusive with Jerguson. By simply turning the two valve handles on the cover it is possible to check gage accuracy *in a matter of seconds.*

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IMPORTANT FLASH!

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unit use forced draft and dissipate 259 million Btu per hr. Two auxiliary cooling towers for auxiliary cooling service dissipate 12 million Btu per hr.

The condenser cooling water is treated with glassy sodium phosphate by three chlorination units, two with 2000-lb-per-24-hr capacity for the main cooling towers and one with 50-lb-per-24-hr capacity for the two auxiliary towers.

Evaporator feed goes through a hot process treatment with a 30,000-lb-per-hr capacity with a 2-hour retention period. Injection tanks and chemical-transfer pumps are provided for feeding phosphate to boiler drums.

Waste water drains to a pond 200 ft wide, 400 ft long and 8 ft deep in the southwest corner of the property. This pond collects all water from such points as boiler blowdown, cooling-tower blowdown, reclaimed water from oil-skimmer tank and overflow from drips of all kinds, to be returned to the ground by seepage.

A 1600-gal skimmer tank removes oil from miscellaneous oily waste water collected in the station, principally from fuel-oil heaters, so oil-free water may be drained to the waste-water drain pond. A floating skimmer arm removes the oil, draining it to a concrete basin where excelsior absorbs it. Excelsior is burned in an incinerator.

Electrical Features. Electric power, generated at 13.8 kv, 3 phase, 60 cycle, is distributed from 115-kv and 70-kv outdoor substations. Main generator connects to step-up transformer bank, consisting of three 20,000/25,000-kva single-phase, 120-72.5-13.2-kv transformers, with a fourth transformer rated 24,000/33,333/41,667 kva as a spare for Unit No. 1 and future Unit No. 2 transformer. Taps from the 13.8-kv generator leads supply the house transformer bank, consisting of three 2750-kva single-phase 13.8-2.4-kv transformers. Connected in the generator leads is a metalclad switchgear containing a 4000-amp compressed-air blast circuit breaker of 2500-kva interrupting capacity, a 2000-amp compressed-air blast circuit breaker of 1500-kva interrupting capacity with associated disconnecting switches and current and potential transformers.

Main generator has a direct-connected 200-kw main and 4-kw pilot exciter. A spare motor-generator exciter stands by for emergency. The generator neutral is grounded through a 50-kva single-phase transformer, the secondary short-circuited with a 50-kw resistor.

Motor-driven station auxiliaries are supplied at 2400 and 480 v, motors larger than 100 hp at 2400 and smaller at 480. The auxiliary power is supplied by the 8250-kva 13.8/2.4-kv transformer bank and the 6000-kw house

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Recommended for the following: Piston rods of high speed and Corliss engines, large and small valve stems, expansion joints, oil rods, plungers, steam hammers, shotgun feeds, stock pumps in paper mills and for all other stuffing box requirements where a good grade of semi-metallic packing is required.

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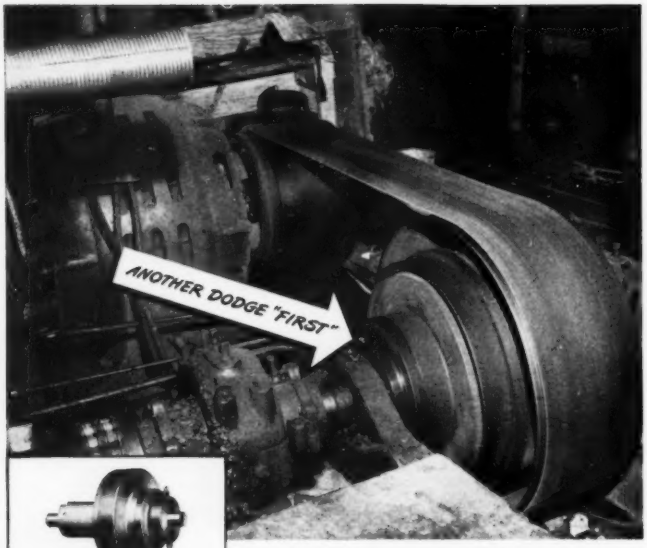

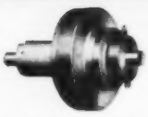

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No toggles! Compact. Extreme flexibility with positive drive.

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turbine-generator. These power sources connect to the 2400-v metalclad switchgear at ground level in the control bay. Power from the 2.4-kv bus is supplied at 480 v through four metalclad unit substations, each having a 750-kva 3-phase 2400/480-v transformer. Two of these are outdoors near the cooling towers. Transformers for the other two are outdoors and connect to the metalclad 480-v switchgear indoors near the 2400-v switchgear.

Practically all motors are squirrel-cage induction-type with splashproof frames. Motors are designed for high ambient conditions of 50 C, and to operate satisfactorily with 65% of normal ac voltage at the motor terminals. All motors except the boiler-feed pump and forced-draft fan motors are started across the line.

A 60-cell 125-v storage battery and two 25-kw battery-charging motor-generator sets are provided for circuit-breaker control circuits, for valve operation and emergency lights. Battery and control board are in control bay.

Performance. Expected over-all steam-generator efficiency, when burning oil, at various steaming rates is:

Output lb per hr	*Over-all efficiency %*
225,000	86.09
340,000	85.80
450,000	84.92
517,500	84.46

Station net heat rate depends on operation of the house turbine. The following table gives the performance with the house unit floating and when it carries entire station auxiliary load:

	Station net heat rate Btu per kwhr	
Station net load kw	*House unit floating*	*Aux load on house unit*
30,000	14,000	15,250
50,000	13,150	13,380
70,000	12,570	12,660

Acknowledgments. POWER is indebted to the Pacific Gas and Electric Co and to the Stone and Webster Engineering Corp for their cooperation in furnishing the data and photographs contained in this description of the Kern Steam Plant in Bakersfield, Calif.

Gas Turbine Report

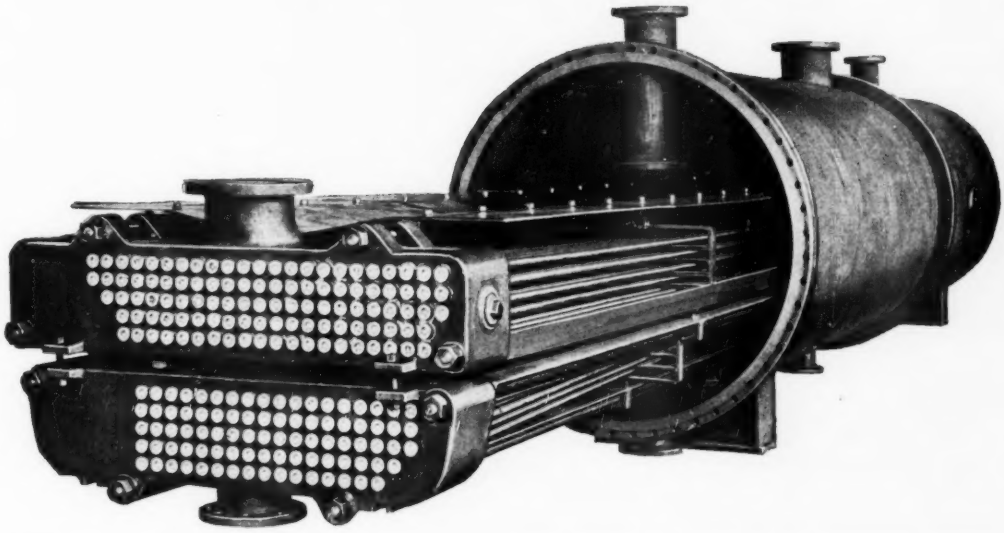
(*Continued from page 117*)

Fig. 8, 9 and 10. This compact unit operates on the simple cycle with 1500-F at turbine inlet, a probable pressure ratio of about 6 or 8:1 (not given

Have You Investigated the

G-R BENTUBE

Scale-Shedding Evaporator?



When you use an evaporator to distill raw water for boiler feed make-up, for process steam, or to obtain pure water for any other purpose, what happens to the scale-forming impurities that are precipitated on the evaporator tubes?

With a G-R Bentube Evaporator, you don't have to worry about their removal. Scale cannot accumulate on G-R Bentube elements in sufficient amount to require hand scaling. This is because of the patented design of these elements, which are set with a slight initial curvature into cast headers. The changes in temperature during operation cause changes in this curvature which continuously crack up and flake off scale accumulations and keep the tubes sufficiently free from scale to maintain rated capacity.

Even where the scale formation is exceptionally rapid or tenacious, hand scaling is unnecessary with a properly operated G-R Bentube Evaporator. In such cases, scale may be cracked off by "temperature shock," obtained by first chilling the evaporator tube surface with cold water and then quickly admitting steam to the evaporator elements.

These units are built in a range of types and sizes for all requirements of industrial plants, process plants and central power generating stations. Each type includes additional distinctive features that assure 100% effective evaporating surface, pure dry vapor, minimum pressure drop of steam through the evaporator, free dropping of scale to the bottom of the shell, and convenient access to the shell interior.

Write for Bulletin 366 describing G-R Bentube Evaporators in detail.

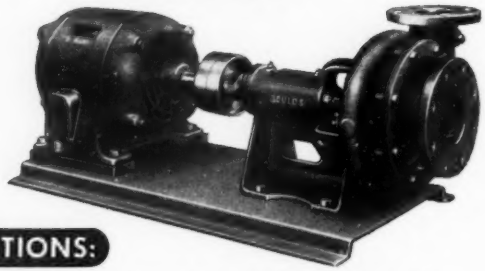
THE GRISCOM-RUSSELL CO., 285 MADISON AVENUE, NEW YORK 17, N. Y.

GR-213

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

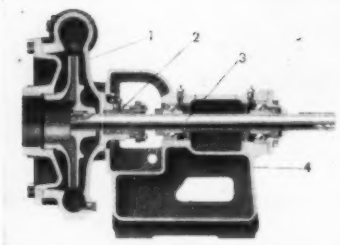
NEW GOULDS Centrifugal Pumps Liquids at Low Cost



APPLICATIONS:

Ideal for liquids, general water supply, circulation, transfer service, irrigation, etc. *Advantages:* Compact simple construction, high efficiency, ease of installation and maintenance, and unusually low prices considering ratings and quality. *Sizes:* 14 sizes for both motor and belt drives. 10 to 1800 GPM, heads to 120 ft. Available in standard fitted, bronze fitted and all iron construction.

ENGINEERED FOR EFFICIENCY



1. **VOLUTE TYPE CASING:** Discharge nozzle swivels to 4 positions. Stud and bolt holes not tapped into liquid passages. Tapped openings for priming, venting, and draining.

2. **STUFFING BOX:** Cast as part of casing. Has bolted gland.

3. **SHAFT:** High strength alloy steel in standard fitted, 18-5 stainless in bronze fitted construction. Has wide spread between bearings to eliminate deflection and vibration.

4. **SUPPORT HEAD:** Has wide openings for easy access to gland and stuffing box. Support is integral part of bearing housing casting. Pump casing and support are permanently aligned by male and female lock fit. Support constitutes collecting basin for gland drip. Ball bearings are "clamp on" type, grease lubricated and held securely to straight, non-stepped shaft.

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in paper). It uses a single-stage centrifugal compressor with two outlets, two combustion chambers, single-stage h-p turbine and single-stage l-p turbine and a reduction gear. The h-p turbine drives the compressor and auxiliaries at 36,000 rpm. In the split-turbine design the h-p element exhausts directly into the l-p 24,000-rpm turbine, which drives the load shaft at 2500 rpm.

Engine weight without accessories is about 150 lbs. Rated specific fuel consumption will vary between 1.5 and 1.0 lb per bhphr depending on the rating and the degree of component refinement ultimately achieved. Rated power can be developed within 15 seconds of initial start. It accelerates very rapidly going from 10,000 (idling) to 36,000 rpm in 5 seconds.

Idle fuel consumption runs about 20% of full load rate. Inlet compressor noise has not been satisfactorily solved as yet. Difficulty stems from the undesirability of introducing any appreciable degree of pressure loss.

The unit will be adaptable to the regenerative cycle at 3:1 pressure ratio. Doubling the engine weight by addition of regenerators (effectiveness not stated) would reduce fuel consumption about 25%.

Gasification at Gorgas

(*Continued from page 79*)

between holes 1 and 2 will be continued as long as high temperatures and CO content persist. If high temperatures are realized but low CO obtained, the gas passage will be successively increased by extracting the gas through the next bore hole. In effect, the arrangement constitutes a 300-ft high-temperature combustion zone followed by a variable-length carbonization zone, giving a flexible experimental arrangement.

Several test holes, fitted with thermocouples sunk in the general area bounding bore holes 1 and 2, will indicate the shape of the area in which the coal has burned. If this area should spread considerably, additional bore holes may be drilled through the overburden to find out whether gasification can be propagated over a tract of land.

The experiment will continue until a maximum of useful data have been gathered. Burning progress will be estimated from test-hole data and from material and energy balances based on air and gas flow through system.

To end operations the underground area will be steamed, flooded with water and then sealed. Flooding and sealing will prevent burning from spreading into adjacent coal. The 4%

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Paying for a larger turbine than you need is a waste of money you can easily avoid. Coppus "Blue Ribbon" Turbines are designed to meet small-power requirements exactly. Made in six frame sizes — fractional to 150 hp, and priced accordingly — they're hard-working, smooth-running, always dependable... the logical, economical drives for your pumps, blowers, fans and similar equipment.

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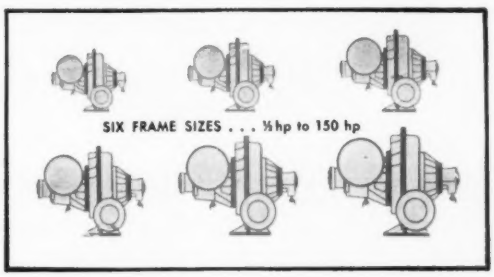
Since 1937, over 85% of all orders for Coppus Turbines have been repeat orders. Add their rapidly increasing use on top-name original equipment and you have conclusive proof of their ability to make good on the job — *your* job.

Send for Bulletin 135-10 COPPUS ENGINEERING CORPORATION, 164 Park Avenue, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.



A QUICK ECONOMICAL way to clean small tubes

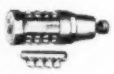
ROTOJET Junior Tube Cleaners offer advantages possessed by no other type. They are light in weight, fed easily with the hose, and shifted quickly from tube to tube.

The ROTOJET Motor is unusually powerful and efficient. It has only two moving parts, a shaft and a paddle. Positive contact, maintained between paddle and Rotocentric (egg-shape) bore cylinder, assures an undivided air stream and freedom from power loss. An air valve permits one-man operation. Models for straight and curved tubes .495" I.D. up. Water-driven models for tubes .953" I.D. up.

ROTOJET size, speed, and ease of operation offer a marked contrast with external cleaners costing many times as much. Send for new bulletin.

Roto Heads are economical

Roto Heads meet practically every cleaning need. Expanding brushes and scrapers have inexpensive replaceable elements for economical operation.



Expanding brush, ball joint, replaceable brush element

Expanding scraper and replaceable element

Wire brush and adapter

Sectional wire brush

ROTOJET *Junior* TUBE CLEANERS

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue **Newark 1, N. J.**

slope from entry portal to bore hole 1 facilitates flooding the shaft.

If needed, a reversing cycle will be used instead of the continuous unidirectional flow. Other alternate operating methods that can be used will be preheating of air entering the ground, induction of steam to the gasification area, cyclic operation as used in water-gas generation, oxygen-steam induction for continuous water-gas production.

First gasification experiment at Gorgas in 1947 (POWER, Dec 1947, pp 106-7) laid the groundwork for the present project, which may be regarded as full scale in extent. The first experiment showed that gases having a heating value from 50 to 319 Btu per cu ft could be produced. Difficulty had been experienced with leakage since maximum cover was only about 30 ft and the outcrop was only on the order of 10 ft from the entries. The present project has an average of 150 ft of cover, and distances from horizontal shaft to nearest outcrop is about 150 ft, with the average distance much greater. To help seal the shaft, all bore holes were grouted under a pressure of 800 psi. Streaks of the grout material were found 6 to 8 ft from the grout hole when uncovered underground.

Both experiments are under the auspices of the Bureau of Mines, U. S. Dept of the Interior, in cooperation with the Alabama Power Co. A bulletin entitled, *The Second Underground Gasification Experiment at Gorgas, Alabama*, describes the history of the method and details of the present layout. It may be obtained by applying to either M H Fies, manager of coal operations, Alabama Power Co, Birmingham, Ala., or James L Elder supervising engineer, Gorgas Underground Gasification Project, Bureau of Mines, U. S. Dept of Interior, Gorgas, Ala.

Plant Problems

(*Continued from page* 136)

blowdown. Mud-drum blowoff should not be used to control water concentration but merely to remove sludge that has accumulated in the mud drum. Concentration control should be handled by continuous blowdown from top center drum.

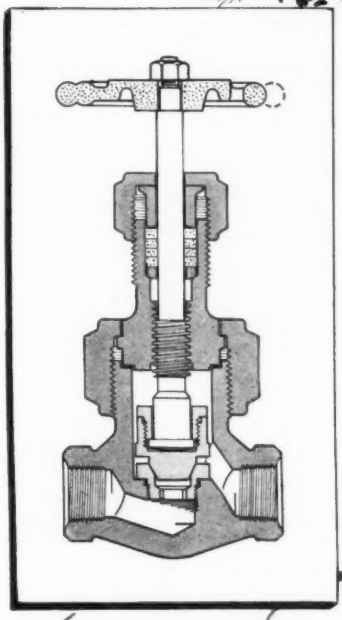
If boiler is operated 24 hr per day, 5 days a week, water should be checked at least once every 8 hr regardless of steaming rates. Of course, type of water treatment is a determining factor in setting up a schedule of control tests.

CHAS A SCHAEFFER, JR
Houston, Texas

(*Continued on page* 176)

"We need 300# Globe Valves that we can install and forget . . ."

"Okeh . . . specify VOGT Series 3430"*



Sturdy drop forged steel valves like these won't let you down. They stay in there pitching year after year on your really tough jobs. Series 3430 valves have drop forged steel bodies and bonnets, 11½-13% chrome stainless steel seats and cone type loose discs. A flat gasket seals the male and female bonnet joint. The stuffing box can be repacked under pressure when the valve is fully open. These valves are also available with 18-8 stainless steel trimmings.

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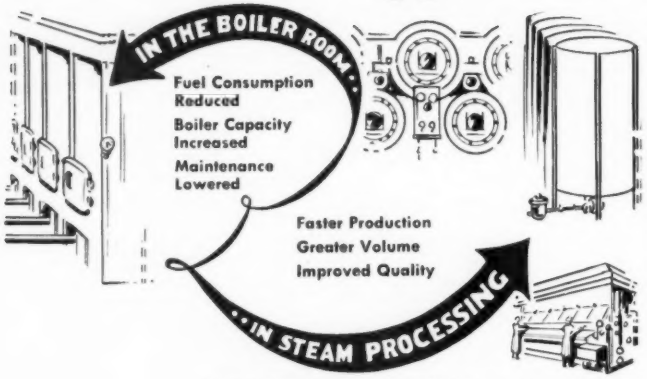
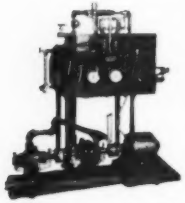


Many industries using steam for industrial processing are cutting fuel consumption 15 per cent, or more, with Stickle Differential Drainage and Boiler Return Systems. These systems return condensate—representing 85 per cent, or more of boiler supply—from processing units to boilers at temperatures only slightly lower than steam at operating pressures, eliminate flash steam waste, and effect other economies.

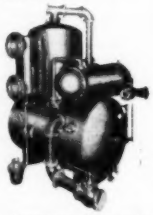
Higher temperatures of boiler supply increase boiler capacities, make drier steam, and assure higher and more uniform pressures. Combined with positive drainage of condensate, these advantages result in higher operating efficiency for processing units.

Results for specific conditions of operation are predetermined and guaranteed. Additional information and data mailed on request.



With Stickle Differential Drainage and Boiler Return System, condensate from steam traps draining processing units is discharged into Receiver Tank from which it is pumped to boilers, under pressure. (Receiver Tank and Pumping Unit shown above). A constant differential pressure between steam supply and return lines is automatically maintained regardless of fluctuation in boilers or supply pressure to units. In addition to saving BTUs in condensate, pumping costs are reduced, and purity of boiler supply and elimination of high velocities is reflected in lower maintenance for boilers, steam lines, and equipment.

Positive and complete drainage of steam condensing spaces permits high operating efficiency of processing units. Steam is dry and supplied at higher and more uniform pressures.



Necessary make-up water is supplied to boilers by Stickle Open Coil Heaters, depleted of scale-forming substances and with non-condensable gases eliminated, at temperature of saturated steam in heaters. One-sixth of make-up is pure distilled water—steam condensed in the heating and purifying process.

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Blowdown From Mud Drum

EXCESSIVE STEAM CIRCULATION in second bank is probable cause of tube plugging. Reducing second bank's gas temperatures and amount of suspended solids in water should remedy condition.

Here are three practical remedies: (1) reduce suspended solids by blowdown from mud drum during banking periods (2) carry lower boiler ratings to reduce circulation in second bank (3) extend length of first bank baffle if the extra draft drop that this introduces is allowable.

A C FRICK *Milwaukee, Wis.*

Equalize the Water Flow

APART FROM the ordinary preventive maintenance and avoidance of steady overloads, *SW*'s cure is to extend height of baffle behind front tubes. This increases proportion of steam formed in front set and reduces steam formed in middle bank of tubes.

Another solution is to equalize circulation in middle bank of tubes by providing orifices for top end of rear tubes in middle row. Leave the tubes that plug open. By restricting flow in some tubes, it is speeded up in remainder. Orifices may consist of short nipples or pieces of tube, with flanges or lugs at one end for easy insertion.

W L GOVAN *Ontario, Canada*

Extend the First Baffle

IN STUDYING *SW*'s sketch, I note the middle bank of tubes is exposed to about the same temperature as front bank, especially front row, which is causing trouble. This intense heat on the middle bank tends to retard downward flow of water in that bank.

Solution is to install a baffle in front of middle bank. This baffle should extend to within three feet of middle drum's lower edge.

R E CROZIER *Detroit, Mich.*

Five Possible Causes of Failure

SW's TUBE FAILURES result from overheating. The plugging he describes may come from one or more sources:

1. *Oil contamination.* Sludge in mud drum and oil in water may combine to form a plugging deposit. External filtering of feedwater by coke, diatomaceous-earth, or burlap is satisfactory.

2. *Corrosion accumulations.* Tube corrosion products and sludge accumulation may be sufficient to plug tubes. Deaeration, internal coating, use of sodium sulphite and a pH value of 11 effectively eliminate corrosion.

3. *Excessive steaming rates.* High steam outputs can cause corrosion of tube material. When operating at high temperatures a chemical reaction be-

SANTOBRITE effective, low-cost SLIME AND ALGAE CONTROL

To eliminate sluggishness and obstructions caused by slime and algae in cooling systems, use Santobrite*— Monsanto's Sodium Pentachlorophenate, Technical. An inexpensive, effective algaecide, Santobrite is recommended for use wherever water is not used for drinking or bathing.

The Santobrite treatment requires no special equipment of any kind . . . Merely add to circulating water at any convenient location. Results are equally satisfactory whether used in large industrial installations or smaller systems.

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controls oxygen corrosion in boiler systems

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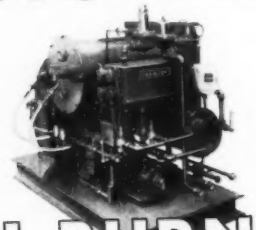

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tween metal and water may occur. Reduction of steam-output rate is necessary to prevent the reaction.

4. *High solids concentration.* Neglect of routine blowdown can cause scale formation and plugging. Blowing down at least once every six hours is necessary to avoid excessive solids.

5. *Old scale.* Existence of scale or corrosive materials present before systematic water treatment has begun could cause plugging. In a recent failure of several tubes in an industrial plant boiler, cause was traced to old scale. Turbining of all tubes and complete washout of boiler is needed to remove such scale.

T G HICKS *New York, N. Y.*

Bead the Alternate Tubes

ELIMINATION of tube plugging in *SW*'s Stirling boiler leans more to the hydrodynamic and mechanical fields for a solution than to the chemical field. Water circulation through tubes must be rapid and adequate to keep tube-wall temperatures down, regardless of load or high boiler ratings. If scale or sludge exists on tube walls, it reduces heat transfer to water, thus tube overheats. If tube is clean but doesn't have sufficient water passing over tube walls to absorb heat, tube will again overheat. The latter seems main cause of trouble in *SW*'s boiler.

Water in boiler, especially at high load is bypassing the tubes, probably because of tube ends and rows nearly at right angles to water flow. Insolubles, as given in analysis of tube deposit, then have both time and extreme heat to bake and build up on lower ends of tubes. I know of one plant with boilers similar to *SW*'s that eliminated this trouble by beading every other tube in the row to equalize water circulation.

If plugging persists in unbeaded tubes, I suggest entire row be beaded over. It's not uncommon to find extending flared ends of tubes in drums, ½-in. long. Tubes shouldn't extend more than ¼-in inside drum for beading over.

A BELTON *Montreal, Canada*

Change the Angle of Baffle

SW's CONDITION IS apparently an unusual one because of the water testing company's good report and failure of the manufacturer's inspector to give a definite answer. I theorize water circulation in second bank of tubes is upward, from bottom drum to top middle drum. This may be attributed to the baffle arrangement behind the first bank of tubes. Baffle top is bent at a 90-deg angle and touches first row of tubes in second bank. Hot gases strike three quarters of tubes' upper section, while bottom section is shielded. As water

(*Continued on page* 222)

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positive power . Roller Chains deliver positive power for the lifetime of the drive. No power is wasted through slippage . . . speed ratios are fixed.

shock absorbing ability . Roller chains have an inherent elasticity that assures a high degree of shock-absorbing ability. This elasticity, plus the chain catenary and the cushioning effect of the oil film between working parts, protects driven equipment against shocks of pulsating loads.

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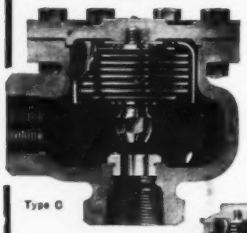
Nicholson Steam Traps
SPEED CIRCULATION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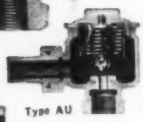
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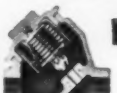
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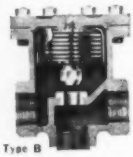
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4. NO DRIBBLING. Close tight when steam is in trap.
5. NO ADJUSTMENT needed for varying pressures.
6. NO WATER-LOGGING. Operate on lowest temperature differential, 5° to 15°, depending on trap size and steam pressure.
7. LOWEST STEAM WASTE. As little as 1%.

5 TYPES for every industrial application. Sizes ¼" to 2"; press. to 225 lbs. BULLETIN 1047.

Control Valves for All Mediums

For steam, water, air, gas, oil; and for all types of operation—lever, foot, solenoid, motor. Choice of 6 metal combinations to meet specific needs. Pressures to 5000 lbs. CATALOG 546.

W. H. NICHOLSON & CO., 125 Oregon St., Wilkes-Barre, Pa.

STRONG • COMPACT • SMOOTH RUNNING

SUMP PUMPS
"by Aurora"

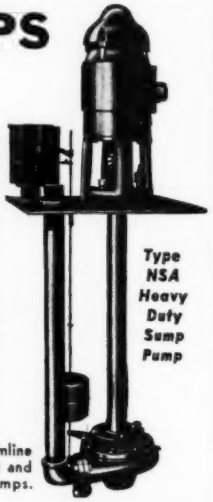
A TYPE FOR EVERY REQUIREMENT • DRAINAGE • LIQUIDS HANDLING In INDUSTRY • TRANSFER OF CHEMICALS & HOT LIQUIDS • SEWAGE • SPECIAL METALS FOR CORROSIVE LIQUIDS

Send for **CONDENSED CATALOG M** *or*

SEE OUR CATALOG IN SWEET'S

Plant engineers are quick to extend their approval to Aurora Vertical Sump Pumps. A perfect combination of latest features, designed to deliver full satisfaction and the ECONOMY of EXTRA years of dependable performance.

Sump Pumps "by Aurora" are available in light duty, heavy duty, and non-clog in submerged (wet pit) type and dry pit type. We shall be glad to send complete descriptive literature.


Type NSA Heavy Duty Sump Pump

ALSO A complete line of streamline design Aurora Centrifugal and Apco Turbine-Type Pumps.

DISTRIBUTORS IN PRINCIPAL CITIES

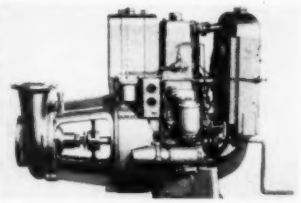
AURORA Always PUMPS — **AURORA PUMP COMPANY**

50 Loucks Street, AURORA, ILLINOIS

New Equipment

(*Continued from page* 154)

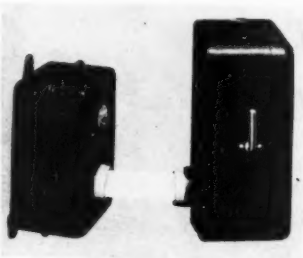
tinuous flow) at 20 psi: No. 110, 300 lb; No. 119, 980 lb; 120, 1650 lb. **V. D. Anderson Co, 1935 W 96th Street, Cleveland, Ohio.**



Heavy-Duty Diesel E173

EXTRA HEAVY-DUTY vertical, 4-cycle, single-cylinder mechanical injection 10-hp diesel engine, the *4FS-1*, has now been made available. Unit has a 4½-in. bore, 5¼-in. stroke, and rates 10 hp at 1200 rpm and 15 hp at 1800 rpm.

The *4FS-1* applies to small stationary and portable power services for belt or chain drive or direct connection. Engine is completely self-contained and ready for service. Ten-gallon tank holds enough fuel for 12-hr operation at full load. **Nordberg Mfg Co, Milwaukee 7, Wis.**



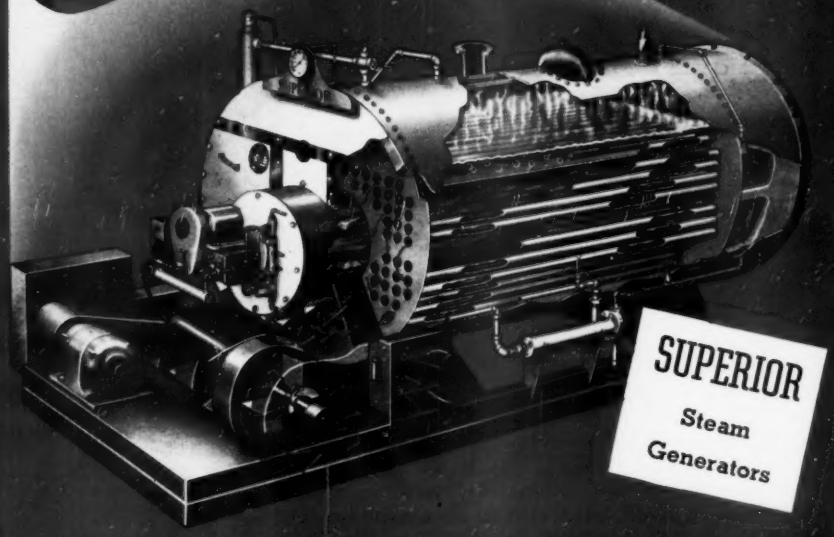
Smoke Indicator E168

SMOKE DENSITY passing through a flue or breeching may be indicated on a record form with a photoelectric smoke indicator—Type *A20C-1*. Unit consists basically of a photoelectric control and light source. A sensitivity adjustment permits setting the equipment to signal at a smoke density held to be the allowable maximum by any established municipal ordinance. **Photoswitch Inc, 77 Broadway, Cambridge 42, Mass.**

Rust Preventive E162

A FIXED PERCENTAGE of phosphoric acid has been incorporated within *Niel-Coat, P-110* to give a stable emulsion, to which has been added a pigment. When this is applied over rusted surfaces the acid reacts with iron oxides and in so doing brings the oils in to form a tough, pliable protective

YOU CAN *See* THE DIFFERENCE



Obviously you can't actually see the 80% guaranteed overall efficiency . . . but you CAN see the evidence of SUPERIOR design and construction which achieves the result.

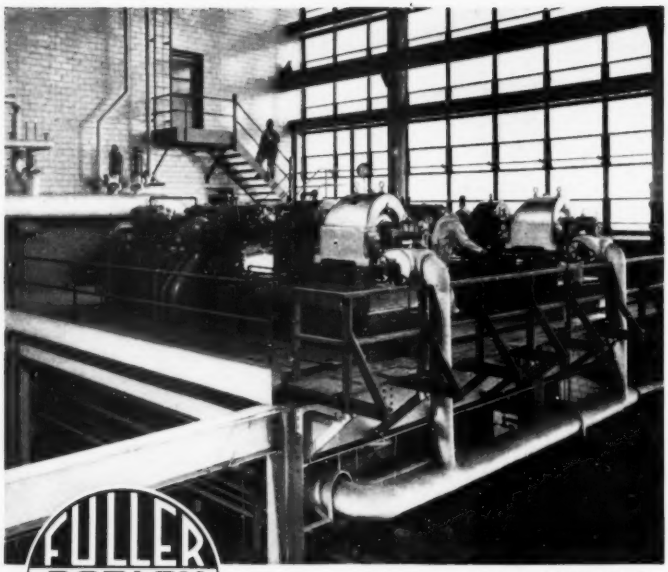
You CAN see the built-in induced draft . . . the 4-pass design with ample heating surface. You CAN see the SUPERIOR Rotary Burner for fully automatic operation with ALL grades of oil (gas or combination gas-oil if you prefer) . . . louvre-type dampers providing minute adjustment of air supply . . . the unusually large steam space (providing ample reserve capacity) . . . the large evaporating surface.

Through an engineer's eyes, it all adds up to Superior performance.

Superior Steam Generators are available in 17 sizes ranging from 20-500 b.h.p. for pressures up to 250 lbs. For complete details, write for Catalog 101.

Superior Combustion Industries, inc.

Factory: Emmaus, Pa.
Executive Offices: Times Tower, Times Square, New York 18, N. Y.



PHOTO—HEDRICH-BLESSING

FULLER ROTARY COMPRESSORS

in

SHERWIN-WILLIAMS

NEW BOILER HOUSE

Two Fuller Rotary Two-stage Compressors are installed in the new boiler house of The Sherwin-Williams Co., Chicago, shown above.

These compressors furnish air for both factory and power-house service. Each has a capacity of 1592 c.f.m., free-air, at 120-lb. pressure, driven by 350 hp. turbine, equipped with speed reducer, to operate at 575 r.p.m.

Fuller Rotaries are ideal units for any industrial plant. They are built in single and two-stage for capacities to 3300 c.f.m., actual free-air delivery, 125-lb. pressure; vacuums to 29.90-in. (referred to 30-in. barometer).

Bulletin C-5 illustrates and describes these machines. We will gladly send you a copy.

FULLER COMPANY

CATASAUQUA—PENNSYLVANIA

Chicago 3 - 120 So. LaSalle St.

San Francisco 4 - 420 Chancery Bldg.

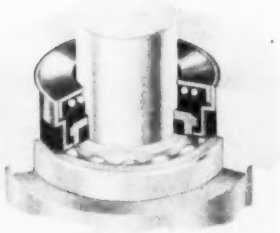
C-180

A LIFETIME OF NEW MACHINE EFFICIENCY

FULLER

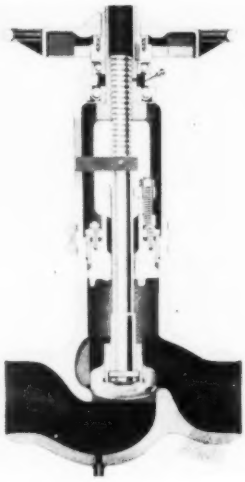
coating capable of resisting atmospheric action and chemical action of acids, alkalis, brines and fumes.

Wire brushing or scraping of surface, plus washing off of oils and dirts with alcohol, naphtha or some similar solvent, is all that needs to be done for preparation of a surface. **Nicleo Laboratories, Detroit 19, Mich.**



Rotating-Shaft Seals E180

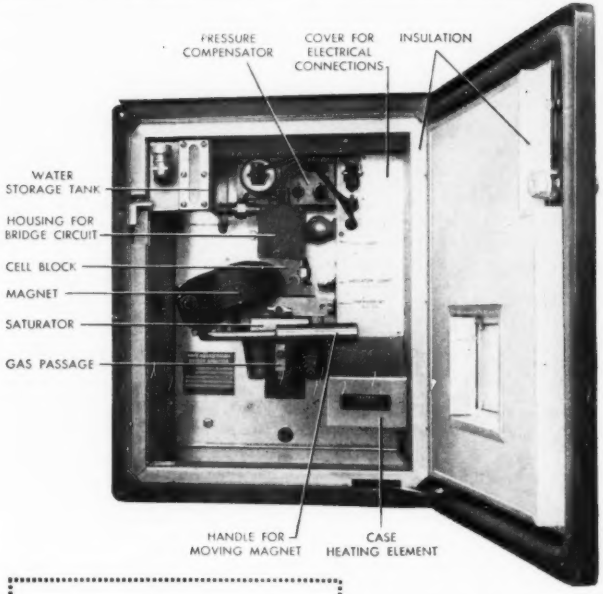
PACKAGED seal unit for horizontal and vertical shafts has rotating and stationary surfaces built inside a metal cartridge. Major parts of seal are the stationary seal ring, diaphragm, spring assembly, and a rotating seal ring varied in shape to suit application. The stationary seal's nose fastens to inner edge of a synthetic diaphragm, with its outer edge fastened to outer seal case. This forms a leak-proof flexible connection between seal case and seal-case nose. A spring holds rotating and stationary sealing surfaces in leakproof contact. **Gits Bros Mfg Co, 1846 S Kilbourn Ave, Chicago 23, Ill.**



Cast-Steel Valve E191

LATEST DESIGN of cast-steel valve makes it possible to economize by installing a size smaller valve in pipelines. Stop and non-return valves in either the globe or angle design use the new body for all sizes 6 in. and above in 900-, 1500- and 2500-psi classes. Valves are available with pressure-

And NOW... AN ACCURATE AND DEPENDABLE METHOD OF DETERMINING OXYGEN CONTENT OF FLUE GASES AS AN INDICATION OF COMBUSTION EFFICIENCY



The HAYS MAGNO-THERM OXYGEN ANALYZER

...OPERATES ON AN ENTIRELY NEW PRINCIPLE BASED ON THE PARAMAGNETIC PROPERTY OF OXYGEN

NOTE THESE 12 VITAL ADVANTAGES:

1. Makes use of the paramagnetic property of oxygen as the basis of measurement.
2. Highly sensitive to changes in oxygen content with rapid response.
3. No chemicals, no liquid or gaseous fuels, no combustion required for its operation.
4. Its super-accuracy is permanently maintained.
5. Not affected by wide variations in rate of flow of gas sample.
6. Rugged construction—no delicate or moving parts. Corrosion-resisting material used where required.
7. Easily installed—small gas line, one small electric conduit—no special fittings.
8. Recorder mounted separate from analyzer at any convenient remote point.
9. As many as four records of O_2 and CO_2 can be provided on one chart, each record continuous and distinct.
10. The presence of hydro-carbon gases and vapors does not affect the operation of the analyzer.
11. Analyzer universally applicable, with sustained accuracy, to all flue gas analysis resulting from the combustion of any fuel with air.
12. Analysis is automatically compensated for barometric pressure, ambient temperature and water vapor dilution.

Usually it is desired to control the combustion process in the boiler furnace so as to maintain the percent of oxygen in the flue gases slightly in excess of the theoretical amount required for the complete combustion of the particular fuel. This is generally the minimum amount of excess oxygen that will result in maximum efficiency of combustion.

The Hays Magno-Therm Oxygen Analyzer provides a direct means of continuously determining the percent of excess oxygen in the flue gases and is a guide to the operator in controlling the oxygen-fuel ratio.

Applicable to all types of boilers and to all kinds of fuel. Particularly valuable where several fuels are burned simultaneously.

Send for the Interesting Story of This New Boiler Room Money Saver... Bulletin 48-829, free for the asking.

The HAYS CORPORATION
Since 1905 — COMBUSTION & INDUSTRIAL INSTRUMENTS & CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

*SONDERGLASS is your best protection against scalding steam and bursting glass.

"We've safeguarded the weakest link in our boiler plant with double layer SONDERGLASS, the safe gauge glass." SONDERGLASS is virtually two layers of hand drawn glass whose components have different coefficients of expansion, fused together; the inner layer resists heat; the outer withstands the shock of sudden cold drafts. It not only minimizes blowout hazards, it also cuts maintenance costs by resisting discolorization and clouding. Replace all water columns with SONDERGLASS now and discover how much better a hand drawn gauge glass can be!

Order from your local jobber and specify "SONDERGLASS — no substitution, please."

SONDERGLASS

THE SAFE GAUGE GLASS

A. W. CHESTERTON CO.

6 ASHLAND ST., EVERETT 49, MASS.

Chesterton

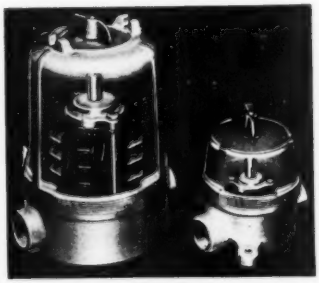
EST. 1884

Manufacturers of famous CHESTERTON MECHANICAL PACKINGS and IMPORTERS of SONDERGLASS

seal or bolted bonnets, and with flanged or welding ends. Pressure loss is decreased by streamlined internal contours that eliminate wear-producing turbulence, by reduction of weight in all floating parts, and by equalization of pressures in all internal areas of the valve. In some sizes weight is reduced to less than 50% of that of the old design. Valve features an integral seat composed of stellite laid directly on valve body. Pressure-seal designs particularly effect a great space saving. **Edward Valves, Inc, East Chicago, Ind.**

Soldering Iron E156

SUPER-POWERED at 700 watts with a replaceable 1¾ in.-dia screw tip, electric soldering iron has its heating element in a hexagon-shaped housing for ease in handling. Iron, Model 700, operates on 110 or 220 v, ac or dc. **Hexacon Electric Co, 131 W Clay Ave, Roselle Park, N. J.**



Explosionproof Switch E204

QUICK-MAKE, QUICK-BREAK rotary snap switch, in explosionproof, dust-tight, vapor-tight weatherproof housing, is designed for hazardous locations. Assembly may be surface mounted with switch handle on dome, or furnished with switch shaft inverted and projecting through base for panel mounting.

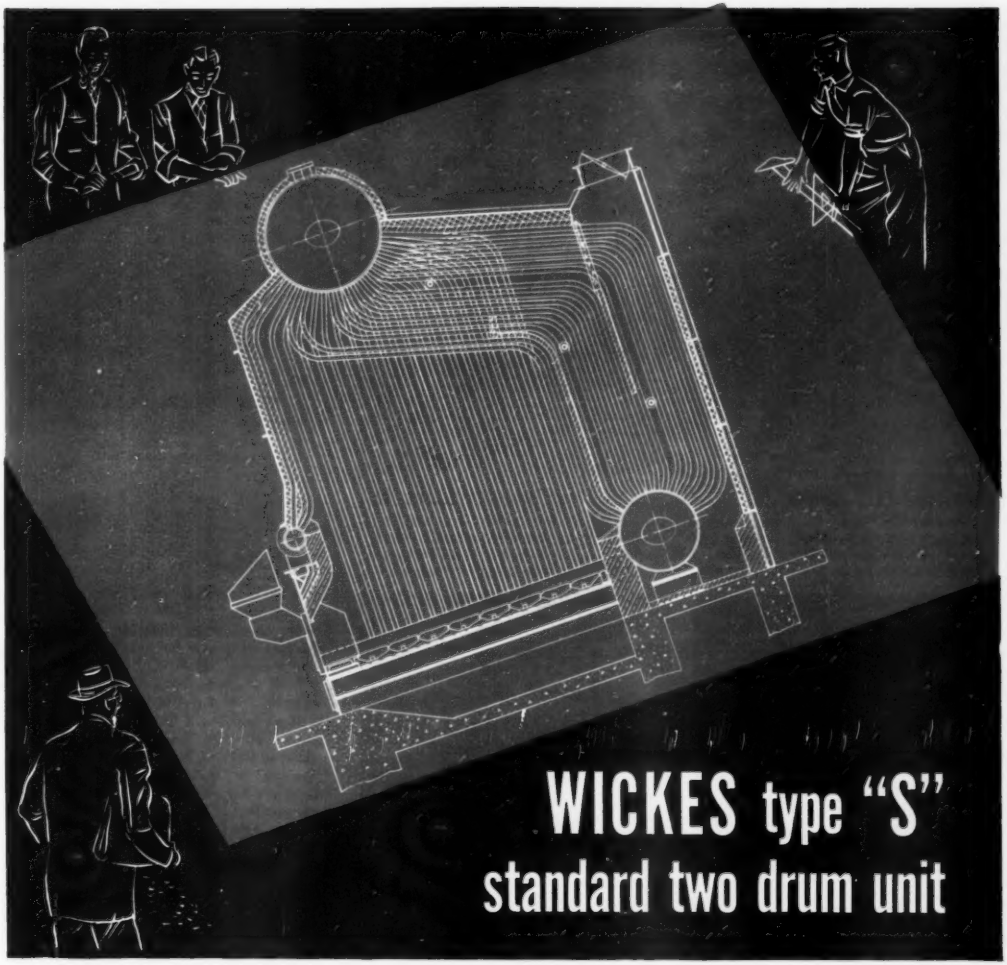
Style 30*H* is rated 30 amp, 500 v, ac; 250 v, dc. Maximum circuit combinations are for 4PST or DPDT for shallow type and 8PST or 4PDT for deep type.

Style 10*H*, for surface mounting only, is a 10-amp, 125-v, ac switch. Maximum circuit combinations in this model are 4PST or DPDT for shallow type and 8PST or 4PDT for deep type. **Electric Switch Corp, Weymouth, Mass.**

Watthour-Demand Meter E208

COMBINATION polyphase watthour and thermal demand meter is in a case no larger than the standard 3-element watthour meter. It is designed for light industrial and commercial loads where it is desired to incorporate demand features within the rate structure.

Combination meter, known as the *CAH*,



the WICKES Boiler Co.

SAGINAW, MICHIGAN

The Wickes Type "S" Standard 2-Drum Unit is designed for industrial plants and particularly where operating and maintenance forces are small. This unit has a generating capacity of 15,000 to 50,000 lbs. steam per hour. It is adaptable to any standard method of firing—oil, gas, single retort underfeed stoker, or spreader stoker, and should the fuel market change, any of the above methods of firing may be readily substituted. With the Type "S" Unit, space conditions are no problem, since the design of the furnace makes this unit a low head boiler. The depth, width and distance between drum centerlines being variable in the standard design, virtually any space situation can be met. Your boiler problems will receive our engineers' consultation and recommendation without obligation.

SALES OFFICES: Atlanta • Boston • Charlotte, N. C. • Chicago • Cincinnati • Denver • Detroit • Houston • Indianapolis • Kansas City • Los Angeles • Milwaukee • New York City • Pittsburgh • San Francisco • San Jose • Seattle • St. Louis • Tulsa • Saginaw • Mexico City • Buenos Aires.

DIVISION OF THE WICKES CORPORATION • RECOGNIZED QUALITY SINCE 1854

$1,500 inventory abolished – at a cost of $4.46!

With more than 700 vacuum tubes needed by industry, a tube distributor would find profits consumed by 100% inventories. But by ordering tubes as needed via Air Express, he holds stocks to 25%. Example: Orders $1,500 tube at 9 A.M. from supplier 900 miles away. Delivered to customer 6 P.M. same day. 16 lbs.: cost, $4.46.

Remember, $4.46 *inc'uded* speedy pick-up and delivery service, too. *More* protection, because you get a receipt for every shipment. Air Express is the *world's fastest* shipping service.

Your Air Express shipments go by the Scheduled Airlines direct to over 1,000 airport cities; fastest air-rail for 22,000 off-airline offices. Shipments *keep moving* with 'round-the-clock service.

FACTS on low Air Express rates

19 lbs. of machine parts goes 600 miles for $3.54.
9-lb. carton of new styles goes 1400 miles for $3.99.
(Every kind of business finds Air Express pays.)

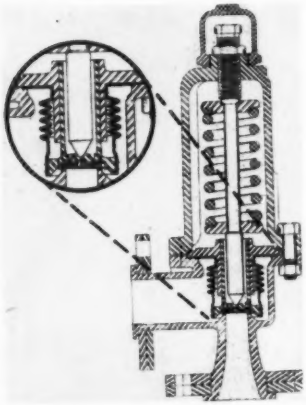
Only Air Express gives you all these advantages: Special pick-up and delivery *at no extra cost. You get a receipt for every shipment* and delivery is proved by signature of consignee. One-carrier responsibility. Assured protection, too—valuation coverage up to $50 without extra charge. Practically no limitation on size or weight. For fast shipping action, phone Air Express Division, Railway Express Agency. And specify "Air Express delivery" on orders.

SPECIFY AIR EXPRESS
AIR EXPRESS
GETS THERE FIRST

Rates include special pick-up and delivery door to door in principal towns and cities

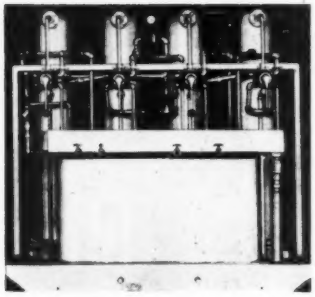
AIR EXPRESS, A SERVICE OF RAILWAY EXPRESS AGENCY AND THE
SCHEDULED AIRLINES OF THE U. S.

is available for 3-phase, 3-wire; 3-phase, 4-wire delta; open Y network; and 3-phase, 4-wire operation in the usual ratings of 5, 15 and 50 amp at 120, 240, and 440 v. **Westinghouse Electric Corp, 306 Fourth Ave, Pittsburgh 30, Pa.**



Safety Valve E190

FARRISEAL bellows completely seals the spring guides, adjusting screws, etc, from vapor or fluid in body of safety valve. Manufacturer says the bellows prevents the the material handled from attaching the guiding surfaces or entering the spring chamber. Manufacturer also states that bellows seal is of particular advantage in connection with backpressure surge applications. Bellows is available in 316 stainless-steel as standard, or in rubber and neoprene for chemical and corrosive-resistant services. FarriSeal bellows have been used where backpressure on bellows has been as high as 150 psi, with satisfactory operation. **Farris Engrg Corp, 453 Commercial Ave, Palisades Park, N. J.**



Demineralizer E183

DEMINERALIZING UNIT removes dissolved mineral salts from water by passing it through beds of ion-exchange resin. Depending upon the hardness of the raw water, and the volume required, these ion-exchange units are available in a variety of sizes and models. A cartridge unit, self-contained and mounted on a convenient wall bracket, delivers about 5 gph. Larger units in both 2- and 4-bed models deliver up to 1000

FOR YOUR HEAT EXCHANGERS OR CONDENSERS, THIS W&T CHLORINATOR CAN:

- Reduce down time
- Cut operating costs
- Improve heat transfer

The machine shown is a W&T Visible Vacuum Chlorinator for the application of chlorine to cooling water circuits through the W&T De-sliming process. Its design is the result of over thirty-five years of pioneering in chlorination, plus the accumulated experience of thousands of installations throughout the world.

Because of the care put into its design and construction, this chlorinator can do these things economically and dependably:

REDUCE DOWN TIME and eliminate costly plug cleaning by ridding condenser tubes of bacterial-induced slime growths.

CUT OPERATING COSTS by keeping condensers and other heat exchange equipment in service longer without shut-down and, at the same time, give higher operating efficiencies.

IMPROVE HEAT TRANSFER by keeping water-side surfaces continuously protected against the formation of a slime layer.

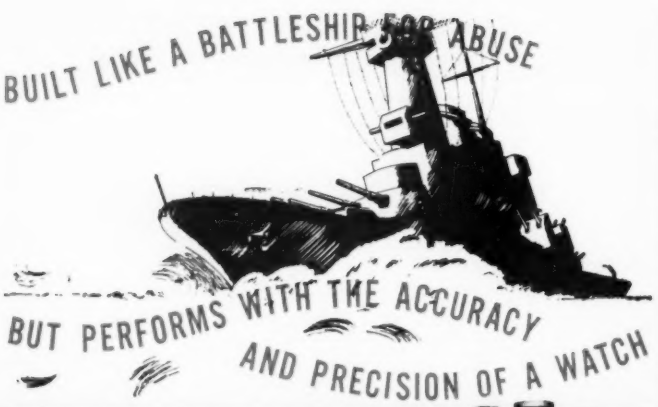
For complete information on how these advantages can go to work for you, write today. There's no obligation.

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

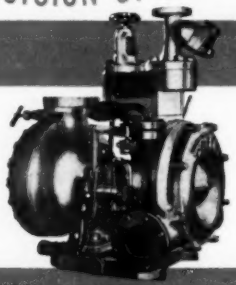
Belleville 9, New Jersey • Represented in Principal Cities

CD-30



COFFIN

Turbo Pumps Deliver 3-to 12-Stage Pump Performance



CHECK THESE PERFORMANCE FEATURES FOR YOUR NEXT JOB...

No destructive cooling erosion or corrosion

No interstage loc ings

Wide range exact pressure governing

Less of suction reduces speed without tripping; automatic speed recovery with suction restoration

High efficiency pumps also high speed

two-bucket rotor hobbies results in minimum steam consumption

Matched Pump, Turbine and Governors under one responsibility.

Exact hydraulic and mechanical balance, light weight rotor, large bearings; results bearing troubles

Pump gland leakoff provides accurate proportioning suction pressure only on packing

Rigid one-piece steel casing plus heavy shaft plus ample clearances result in no damage from dry operation

All parts made in proper heat treatment

Complete with fittings all parts in stock at factory with recurring parts available from agencies' stock

Proved for performance over a period of more than twenty years in service

Compact, light in weight, quiet and

COFFIN PUMP REPRESENTATIVES SERVE ALL OF AMERICA'S INDUSTRIES

L. O. Arningdale, New York, N. Y.
Robert Bacon Company, Newton, Massachusetts
Beeson Bros. Engineering Co., Los Angeles, California
Stuart D. Brown, Sewickly, Pennsylvania
The H. Berry-Detroit Company, Detroit, Michigan
Cordes Brothers, San Francisco, California
J. M. Costello Supply Co., Wilmington, California
John N. Fehlinger Co., New York, N. Y.
Fuel Economy Engineering Co., Saint Paul, Minnesota
J. W. Himmelsbach, Chicago, Illinois
International Railway Supply Co., New York, N. Y.
C. E. Johnson & Associate, Atlanta, Georgia
William F. Lewis, Kenmore, New York
Maleson Company, Philadelphia, Pennsylvania
John H. Marvin Co., Seattle, Washington
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Warren M. Wilson Co., Cleveland, Ohio
Marine Specialty Co., Mobile, Alabama
P. Thompson Tool & Supply Co., New Orleans, Louisiana

FREE

A complete 4-page illustrated bulletin on COFFIN TURBO PUMPS with all operating data, applications, specifications, that you may require for your next job. Write for Bulletin "S" today.

165

INDUSTRIAL RAILROAD COFFIN MARINE PRODUCTS

The J. S. COFFIN, JR., COMPANY

326 SOUTH DEAN STREET, ENGLEWOOD, NEW JERSEY

gph. Special units of any capacity are engineered to requirements. **Industrial Filter & Pump Mfg Co, 1621 West Carroll Ave, Chicago 12, Ill.**

Portable-Pump Unit E181

UNIT consists of a gearless pump powered through a V-belt by a 1½-hp single-cylinder air-cooled gasoline engine. It is designed for service where a portable emergency pump is required. Belt can be removed by raising the pump, which is hinged. When pump is not in service, engine can be used for other power purposes. Total weight is 15 lb. It is 18x18x15 in. **Eco Engrg Co, 12 New York Ave, Newark 1, N. J.**

Solderless Connectors E203

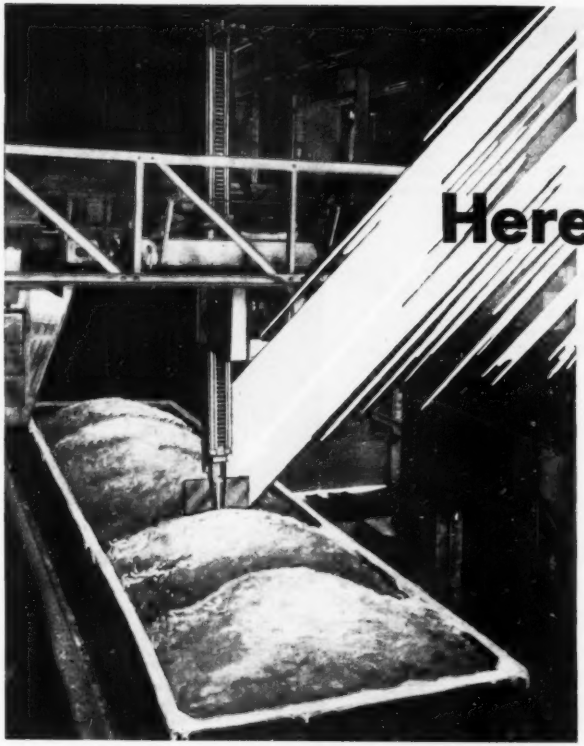
USE OF SILVER on all current-carrying surfaces means no oxidation problems, low contact loss, long life and low maintenance. Complete line of these solderless connectors features serrated silver contact surfaces and interlocking sides to accommodate a wide range of conductive sizes.

Among types of connectors available are straight, tee, block terminal, angle, parallel, and ground; in both Class *A*-1 and *A*-2. **General Electric Co, Schenectady 5, N. Y.**

Safe Trouble-Lamp E207

CALLED SAF-T-LITE, this portable extension light taps off the secondary of stepdown transformer, which in itself is portable. Transformer weights only 4¼ lb and reduces 110 v of the primary circuit to 6 v, which is impressed on the lamp.

Unit safeguards industrial workers in damp or wet locations from possibility of fatal electric shock. Safety transformer is protected by a waterproof bakelite casing



Here's a Ray of Sunshine

on the Problem of *Unloading* Hopper Cars of FROZEN COAL

At last a device is available for unloading Hopper Cars of Frozen Coal without the use of heat and without damage to the cars.

The photograph shows a Kinney Car Unloader, manufactured and sold only by Heyl and Patterson, in operation on a carload of frozen coal at the Marysville Power Plant of the Detroit Edison Company.

The Kinney Car Unloader, which can also be used in a limited way as a Car Mover, consists of a movable bridge equipped with a trolley which carries the Unloading Spade and its operating mechanism. The bridge may run on a Crane Runway or may be designed as a Gantry or other type of bridge.

The coal is unloaded through the normal hopper openings in the bottom of the car. By a coordinated movement of the trolley and the bridge it is possible to place the spade in any position over the car.

Sufficient force can be applied to the ram carrying the spade to drive it down through frozen coal, forcing it through the hopper openings.

The spade can swing through an arc and move coal down into the opening previously made.

With the Kinney Car Unloader, one man can unload a 70-ton car of frozen coal in 20 minutes or less.

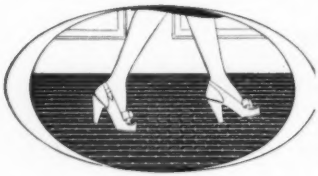
The Kinney Car Unloader is manufactured and sold only by Heyl and Patterson. Ask an H & P Engineer to consult with you on your problem of unloading hopper cars of frozen coal.

Ore Bridges
Railroad Car Dumpers
High Lift-Turnover-Rotary
Coal Preparation Plants
Coal & Coke Handling Equipment
Boat Loaders and Unloaders
Rotary Mine Car Dumpers
Coal Crushers
Coal Storage Bridges
Car Hauls & Boat Movers
Bradford Breakers
Refuse Disposal Cars
Thorsten Coal Samplers
Kinney Car Unloaders
Pig Iron Casting Machines

Heavy Bulk Materials Handling Equipment
***All the Way from* DESIGN to ERECTION**

Heyl & Patterson, Inc.
"SINCE 1887"
55 WATER STREET · PITTSBURGH 22, PA.

THE **SAFE**
OPEN STEEL FLOORING
IS **TRI-LOK**



No object over ½ square inch can pass through super-safe U-Type Tri-Lok Flooring. Fabricated without bolts, rivets or welds, it is unsurpassed for plant installation, walkways, loading platforms. Efficient distribution of concentrated loads . . . maximum free opening for light and air. Write for Bulletin JZ 1140.

DRAVO CORPORATION

National Distributor for the Tri-Lok Company

Dravo Bldg., Pittsburgh 22, Pa.

Sales Representatives in Principal Cities

DRAVO

Learn the secret of
BIG EARNINGS
in Combustion Engineering
Through the Hays easy reading home study course

High power plant costs today have opened up big opportunities for men who know the means of producing efficiency and economy in power plant operation. The above booklet sent to you without obligation, will tell you of the easy way to become a Hays trained Combustion Engineer, in a little of your spare time, through the easy reading, low cost, Hays Home Study Course in Fuel and Combustion Engineering. Send for it now.

Approved for Veterans. Our 30th Year.
HAYS INSTITUTE OF COMBUSTION. Dept. 14
430 North Michigan Ave., Chicago 11, Illinois

HAYS INSTITUTE OF COMBUSTION
430 N. Michigan Ave., Chicago, Ill. Dept. 14

Name_____

Address_____

City_____ State_____

Company Name_____

that will withstand extreme physical and chemical abuse. When connected to an outlet, the unit can be left on floor or may be hung from any wall fixture by convenient hook. A second unit is also available which reduces 220-v lighting circuit voltage to 32 v for lamp operation. This second model is designed for service in working areas where increased wattage for general lighting is desired. **Etraco Mfg Co, Woods Church Road, Flemington, N. J.**

Protective Coating E155

A PLASTIC-BASED PAINT, *Metalast* withstands acids, chemicals and salts for long periods of time, states the manufacturer. It can be applied to steel, aluminum, galvanized iron, ferrous and nonferrous alloys at atmospheric temperatures. It has abrasive qualities that resist chipping or peeling. To apply, clean all metal surfaces of old paints, oil, grease and loose rust, then brush or spray on the *Metalast*. **C A Woolsey Paint & Color Co, 229 E 42nd St, New York, N. Y.**

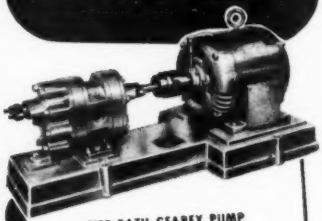
Demineralizing Unit E128

MODEL 200 *Belco* packaged demineralizer has a maximum flow rate of 60 gph and an exchange capacity of 14,000 grains as $CaCO_3$. Unit is completely self-contained. Regenerant containers are concealed in a cabinet. Tanks are rubber-lined and piped with *Saran* piping and tubing; operating valves are *Everdur*. Automatic controls shut the unit off when a predetermined degree of impurity in the demineralized water is reached. **Belco Industrial Equipment Div, Inc, 102 Iowa Ave, Paterson 3, N. J.**

Floor Covering E166

A COMBINATION of donerite and quartz fluxed with a cement gives a floor-surfacing material so tough that floor patches formerly requiring a 1¼ to 2 in. thickness for strength can be put in down only ½ in. thick. *Rockflux* is unaffected by oil and grease. It permits free and easy rolling of equipment because its pressure resistance is high, three times that of ordinary concrete. **Flexrock Co, Filbert & Cuthbert, Philadelphia 4, Pa.**

SIER-BATH ROTARY PUMPS *have no time for down-time*



SIER-BATH GEAREX PUMP

Balanced axial thrust . . . pulseless flow . . . vibrationless operation . . . roller bushings for precision running under load.

Pumps: oils, varnishes, solvents, molasses, chemical solutions.

Capacities: 1-350 g.p.m.

Discharge: 250 psi for medium or high viscosities. 30 psi for water.

For higher pressures and capacities use SIER-BATH SCREW PUMPS.

A notable feature of Sier-Bath Rotary Pumps is their relative freedom from down-time for repairs and maintenance. Built in a shop equipped for manufacture of the finest precision gears, Sier-Bath Pumps show surprising ability to stand up under the most rugged operating conditions. The value of such sturdy construction cannot be over-emphasized in these days of high operating costs.

ALSO MAKERS OF SIER-BATH PRECISION GEARS

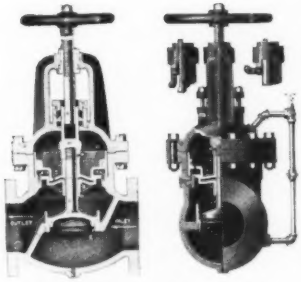
FOUNDED 1905 MEMBER A.G.M.A.

Sier-Bath
GEAR and PUMP CO., Inc.
9254 HUDSON BLVD., NORTH BERGEN, N J

Positive Safety When Engine Turbines or Compressors Overspeed

GOLDEN-ANDERSON

throttle and automatic engine stop VALVES



G-A Combined Throttle and Automatic Engine Stop Valve, Globe Pattern.

G-A Throttle and Automatic Engine Stop Valves give instant, automatic protection from damage when turbines, compressors or engines overspeed. Remote control system also permits valve operation from any station through a system of Solenoid Trip Pilot Valves. "Double Corliss" dashpot assembly effectively cushions the valve, preventing banging, chatter or spinning under any flow condition.

Valves are furnished extra heavy throughout, with the result that no distortion or warping is encountered under stress or strain. Available in standard or toggle yoke designs, angle, globe, elbow patterns. Let us work with you on any difficult Valve problem.

LIFE AND PROPERTY PROTECTION
VALVES SINCE 1905

GOLDEN-ANDERSON *Valve* **SPECIALTY CO.** Keenan Building, Pittsburgh 22, Pa.

HOW YOU SAVE,
Getting Drier Compressed Air

● Direct saving in the cost of cooling water saves the price of the Niagara Aero After Cooler (for compressed air or gas) in less than two years.

Extra, for no cost, the drier air gives you a better operation and lower costs in the use of all air-operated tools and machines, paint spraying, sand blasting or moisture-free air cleaning. Water saving also means less expense for piping, pumping, water treatment and water disposal, or you get the use of water elsewhere in your plant where it may be badly needed.

Niagara Aero After Cooler assures all these benefits because it cools compressed air or gas below the temperature of the surrounding atmosphere; there can be no further condensation in your air lines. It condenses the moisture by passing the air thru a coil on the surface of which water is evaporated, transferring the heat to the atmosphere. It is installed outdoors, protected from freezing in winter by the Niagara Balanced Wet Bulb Control.

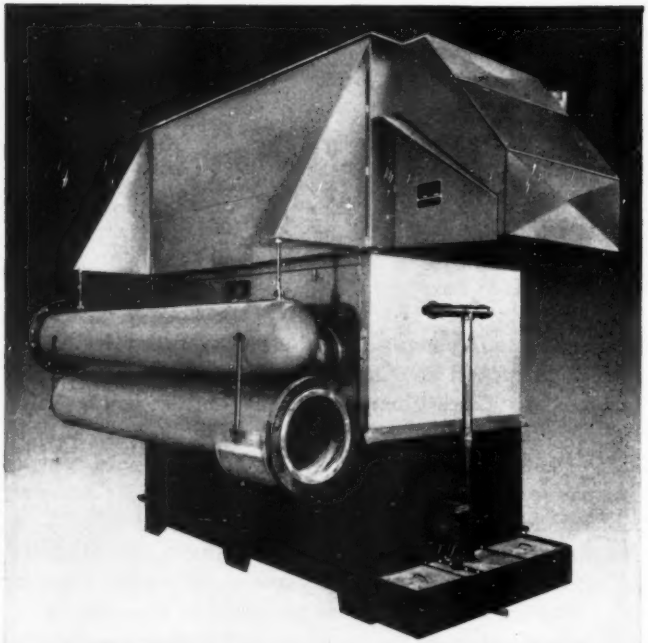
Write for complete information; ask for Bulletin No. 98

NIAGARA BLOWER COMPANY

Over 35 Years of Service in Industrial Air Engineering

Dept. P, 405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities



INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

Power News

(*Continued from page* 142)

flyash, thermal and flow regulation, controller dynamics in electro-mechanical systems, atomic power, vertical circulating pumps and steam turbines. Also, there will be reports on distribution systems, central station operation, heating and air conditioning, steam contamination, heat pump, dual-fuel engines, gas turbines and electronics.

New Mercury Unit Power Plants at Hartford

First postwar mercury unit power-plant equipment has been placed in operation in the South Meadow Station of Hartford Electric Light Co, Hartford, Conn. Designed and supplied by General Electric, the equipment uses mercury vapor at 113 psig, 945 F to drive a mercury turbine at 720 rpm. The unit generates 15,000 kw while supplying about 200,000 lb of steam per hr at 400 psig, 700 F to drive existing steam turbines.

The new installation replaces a smaller unit that has been in service for 20 years. The old unit, also built by General Electric, was the first large mercury unit installed in this country. Rated at 10,000 kw, it has given satisfactory service since 1928. Prior to the war there were only two other large mercury turbine installations in the world. Hartford Electric Light Co has been the pioneer utility in the mercury turbine field, working closely with General Electric to produce an efficient unit for superposing on steam installation. It is expected that more mercury-unit power plants will be installed in the future, according to GE engineers.

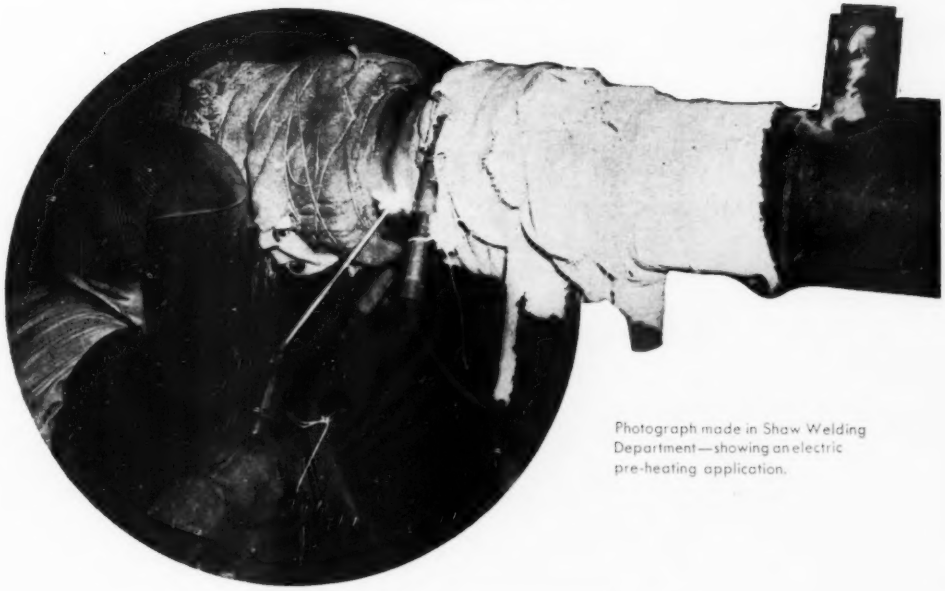
Georgia Power Co will spend $24,000,000 this year on its construction work, including more than $8,500,000 in new power-generating facilities, according to President C B McManus. No new public financing will be necessary this year, but some is contemplated in 1950, when a like budget will go into operation.

More than $5,000,000 will be used to continue construction of Plant Yates on the Chattahoochee River near Newnan. This 200,000-kw plant is expected to be completed late in 1950. Two units will be installed with space provided for two additional 100,000-kw units.

Nearly $2,000,000 will be needed to complete Plant Mitchell near Albany. The first 22,500-kw units went into service last Dec and another 22,500-kw unit is expected to be completed this spring.

Of special interest is the decision to resume work on the 50,000-kw Furman Shoals plant on the Oconee River near Milledgeville. This project was started in 1929 but work was suspended in 1931. Schedule now calls for completion in 1952.

piping for power generation . . .



Photograph made in Shaw Welding Department—showing an electric pre-heating application.

no matter what your piping project, Shaw's dependable piping fabrication and installation service is a wise selection. Modern equipment, ample facilities, tested engineering skills and an alert service assure you the highest standards of performance, efficiency and economy. Shaw installations throughout the world are evidence of this ability. Your inquiry is invited.

KNOWN SINCE 1893 FOR HIGH-QUALITY PIPING PRE-FABRICATION AND INSTALLATION

Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping throughout the world.

Benj. F. Shaw III

President

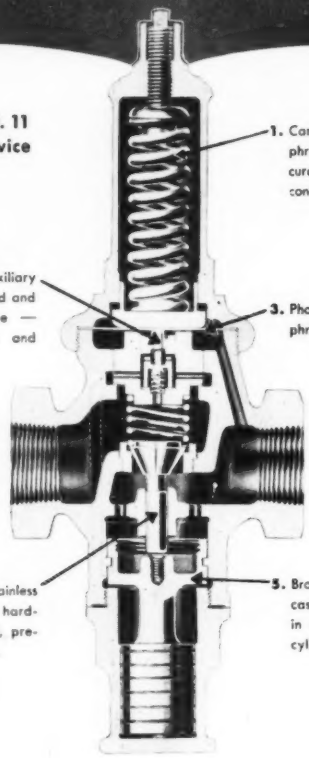
BENJAMIN F. SHAW COMPANY

2nd and Lombard Streets Wilmington, Delaware

5 Quality Features

THAT ASSURE LOW COST PRESSURE REDUCING SERVICE

MASON NO. 11
for Steam Service



1. Carefully calibrated diaphragm spring insures accuracy throughout entire control range.
2. Stainless steel auxiliary valve unit, hardened and ground pilot valve — eliminates sticking and wire drawing.
3. Phosphor bronze diaphragm.
4. Special alloy stainless steel main valve, hardened and general, prevents steam cutting.
5. Bronze piston fitted with cast iron rings operates in ground and polished cylinder.

The No. 11 Mason Reducing Valve assures precise pressure control in all types of applications. Pilot operation assures fast, accurate response to controlled pressure variations. Initial pressure ranges up to 250 lbs. reduced to any desired pressure between 5 and 75 lbs. or 75 and 225 lbs. Bronze bodies, screwed connections in sizes ½" to 2". Iron bodies, 250 lb. flanges in sizes 2½" to 4". Maximum working pressure 250 lbs. @ 450° F.

Your local Mason-Neilan industrial distributor is ready to serve you from his stock

MASON-NEILAN REGULATOR COMPANY
1186 ADAMS ST., BOSTON 24, MASS., U.S.A.

Sales Offices or Distributors in the Following Cities: New York • Buffalo • Chicago St. Louis • Philadelphia • Houston • Pittsburgh • Cleveland • Tulsa Atlanta • Denver • Cincinnati • Los Angeles • San Francisco
Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

Water-Conditioning Firms Join Forces

Two old-timers in the water-conditioning field—Elgin Softener Corp., Elgin, Illinois, and Illinois Water Treatment Co, Rockford, Illinois—have joined forces.

Under the new setup, each company will maintain its name identity and personnel. Associated with Chester T McGill, of Elgin, are such well-known men as E W Scarritt, C Scribner and B F Willey, each of whom has had some 20 years' experience in the field, and W S Morrison and P H Ca-key, of Illinois Water Treatment, pioneers in development of de-ionizers.

An important part of the plan is an integration program that will broaden scope of services available through a nation-wide organization of sales engineers and technical field men with offices in 40 principal cities. This will permit close personal attention to be given all phases of water conditioning, including special ion-exchange problems.

As Elgin has devoted some 40 years exclusively to technical advances in science of water conditioning, it has established a manufacturers' division to make available its improved techniques to other manufacturers in the industry. Zeolite is also being made available through Elgin's recent acquisition of Arizona Minerals Corp. Yuma, Arizona, producers of this material.

Boyer Predicts Increase In Dual-Fuel Engines

"A substantial percentage of the diesel engines produced in America over the next several years will be of the dual fuel or gas-diesel type." This prediction was made by Ralph L Boyer, vice-president and chief engineer of Cooper-Bessemer Corp, before the annual meeting of Society of Automotive Engineers in Detroit. Several cost-saving benefits will largely account for this growing preference for diesel engines that can be operated either on gas, on oil, or on any combination of gas and oil, as may be determined by supply and cost of either fuel.

In section of the country where gas supply is subject to sudden cut-off as under adverse weather conditions, the dual-fuel or gas-diesel engine will assure operators, such as municipal and industrial power plants, of uninterrupted power generation. With this type of engine, if the gas supply is curtailed, the engine controls will automatically switch over to oil-diesel operation, drawing entirely upon the fuel-oil supply and maintaining a constant fuel input to the engine. As the gas supply is restored, the engine controls again provide proper compensation by decreasing the rate of fuel-oil injection and correspondingly increasing the gas input. "As a matter of fact, this very feature enables the operator of the dual-fuel engine to get a still better cost rate from the gas supplier," Boyer goes on to explain, "for in his contract it can be arranged that he, the user, may be cut off should the gas supplier find it necessary to do so."

WOULDN'T YOU LIKE

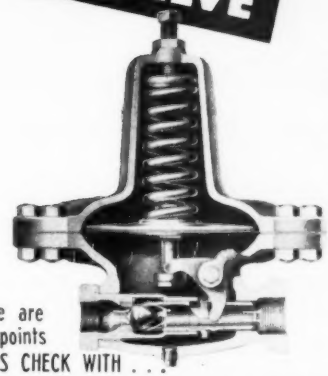
to say

GOODBYE

TO THESE TROUBLEMAKERS

YOU CAN DO IT WHEN YOU INSTALL THE

CASH STANDARD Streamlined PRESSURE REDUCING VALVE TYPE 1000



A few Typical

USER STATEMENTS

"In our business where we must CONTROL OUR STEAM PRESSURE and the curing temperature TO THE FINEST DEGREE, we have found that the CASH STANDARD Type '1000' valves HAVE MET ALL DEMANDS, giving us the type of cure that is so necessary to an acceptable molded product."

—from a Production Manager

"We have confidence in the performance of the CASH STANDARD '1000' and USE IT EXCLUSIVELY with oil firing control assemblies."

—from an Engineering Corporation

"The two CASH STANDARD Type '1000' pressure reducing valves that we use have, since their installation, GIVEN PERFECT OPERATION WITH NO MAINTENANCE."

—from a Laboratory

"The CASH STANDARD Streamlined Valves we have are DOING A SPLENDID JOB. WE CAN NOT RECALL ANY MAINTENANCE ON SAME AS YET. Some have been IN SERVICE 4 OR 5 YEARS."

—from an Axle Manufacturer

"We have two of these valves in operation on air pressures of 130 lb. and HAVE FOUND THEM TO OPERATE SATISFACTORILY on this pressure down to 60 lb., which are the only pressures we use."

—from a Manufacturer

These are the points USERS CHECK WITH . . .

1. **Maximum capacity when needed most.**
2. **Accurate pressure control under toughest working conditions.**
3. **Trouble-free service.**
4. **Smooth operation.**
5. **Tight closure.**
6. **Speedier production results.**
7. **Elimination of failures.**
8. **Cost-saving operation.**
9. **No spoilage.**
10. **Practically zero in maintenance.**

Send FOR BULLETIN 962

CASH STANDARD CONTROLS.. VALVES

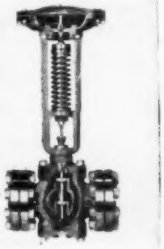
A. W. CASH COMPANY

DECATUR, ILLINOIS

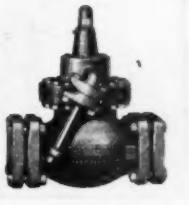
BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

Send for them

Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.



Bulletin 968 features the CASH STANDARD Type 34 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications. Three pages of capacity charts.



Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

SAVED 35%
steam consumption
The fuel-saving value of steam system modernization with Hoffman Specialties is well illustrated in the case of an internationally famous maker of farm implements. After installing Hoffman Traps on the radiators—a job requiring 700 units—steam consumption for heating dropped 35% with corresponding fuel savings.

CHECK YOUR OLD TRAPS NOW

The fuel shortage loses most of its terrors when the remarkable results being accomplished by steam plant modernization are considered. In plants the country over, replacing worn out, inefficient equipment is enabling operators to maintain full heat requirements on reduced amounts of fuel. Modernization of heating equipment cannot be considered an expense, but a safe investment paying substantial dividends in fuel saved and a protection against production loss.

Hoffman Steam Specialties make any heating plant modernization a genuine success. Not only are they recognized as highly efficient units, but they have features which amazingly prolong service life.

They are so constructed that all parts subject to wear can be easily and inexpensively renewed —no need to junk an entire unit because of a worn seat. All together, these traps are a rare combination of sound design and excellent material, assembled with genuine pride in good workmanship.

CHECK THESE SPOTS

\ STEAM RADIATORS
\ UNIT HEATERS—PIPE COILS \ DOWN-FEED RISERS \ CONDENSING RADIATORS
\ BLAST COILS
\ ENDS OF STEAM MAINS, ETC.

Sediment accumulations, worn seats and pins, "dead" thermostats—any one of these may be causing a serious loss of steam. The only way to guard against this waste is to open up your traps—*once a year at least*—and eliminate the troublemakers. Remember that the tiniest steam leak, during a year's operation, can waste an unbelievably large amount of fuel.

CLEAN-OUT AND INSPECTION IS EASIER ON HOFFMAN-EQUIPPED SYSTEM

This heavy duty trap does a precision job under toughest service. All working parts are mounted on the cover — *easily removed for cleaning without breaking pipe connections.* Reversible Valve Pins and Seats assure longer life.

HOFFMAN 50 SERIES TRAP

HOFFMAN STEAM TRAPS

HOFFMAN SPECIALTY CO., Dept. P-4, 1001 YORK ST., INDIANAPOLIS 7, IND.
MAKERS OF HOFFMAN VALVES, TRAPS, VACUUM AND CONDENSATION PUMPS, FORCED HOT WATER HEATING SYSTEMS

Leak Detector Tests 13 Miles of Tubing

A General Electric Type H leak detector was employed recently to test for leaks in 13 miles of copper tubing being used for a special project at the company's research laboratory.

According to John S Hickey, a research-laboratory engineer, this application of the instrument was necessitated by the laboratory's requirement for a large quantity of copper tubing completely free from leaks. The tubing, intended for use as a watercooled conductor to operate in a vacuum chamber, had a $\frac{1}{8}$-in. outside diameter with a .015-in. wall. It was obtained in 100-ft lengths and induction brazed into mile-long lengths for use.

Hickey said a mixture of eight parts nitrogen to one part Freon was bled into the tubing, while the far end remained open, until samples of the escaping gas were found to contain Freon, as shown by the leak detector. A valve on the end of the tubing was then closed and the pressure built up to 600 psi. Preliminary bleeding of the air was necessary, Hickey said, to prevent the tubing at the far end of the coil from retaining only air.

Except for about five ft at the ends of the coils, which were tested by hand, the actual leak test was conducted by running the tubing through a special pickup at about one ft per second, using a motor-driven winding drum and a simple friction brake on the supply drum.

In the first test (on 13 miles of tubing having about 675 joints) seven leaky joints, two porous sections of tubing, and three folds were found, according to Hickey. The leaky joints were poor braze jobs; the porous sections were 100-ft coils that had many leaks per ft over the entire length. The folds, he said, apparently were ingot flaws that closed up on drawing the tubing and were not visible to a casual inspection with the naked eye.

He explained that each reel was given a final check by putting it, fully charged with gas, into a cardboard box for a week. The box air was then tested for Freon. One reel was found to have a leak. It was re-run on the test bench and a leaky joint found. This joint, he pointed out, may have cracked when it was wound on the reel after the first test. Subsequent experience with the tubing has shown that the GE Type H leak detector found all the leaks that had existed, he said.

Bailey Meter Co, Cleveland, Ohio, has announced another large expansion of its staff of field engineers. Twenty-seven men, all engineering graduates of universities or technical schools, have completed the company's special training program, a requisite for all Bailey Meter engineers, and eleven are now being assigned to various branch offices. The training program consists of a study of principles of combustion and theory and practice of measurements and control as applied to power and process problems. Factory training in assembly and calibration of Bailey meters and controls is combined with lectures by experienced Bailey engineers and factory specialists.

Reader Service Page for . . .

NEW EQUIPMENT, TECHNICAL LITERATURE

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

AIR CONDITIONING, HEATING, REFRIGERATION AND VENTILATING

1 SHUTTERS AND PENTHOUSES—L J Wing Mfg Co, 154 W 14th St, New York 11, N. Y. 4-page bulletin No. SH-1 discusses Wing shutters and penthouses. Dimensions are given.

2 TUBULAR HEATERS—Black, Sivalls & Bryson, Inc, 730 Delaware, Kansas City 6, Mo. 24-page general catalog No. 54, section 3, part 5, gives types of tubular heaters available. Construction features, applications and specifications are included.

3 WINDOW FANS—Chelsea Fan & Blower Co, 1206 Grove St, Irvington, N. J. Catalogs No. 863 and 864 cover specifications, dimensions, photos, etc, of a full line of fans for commercial, residential and industrial applications.

4 FORCED AIR SPACE HEATER—Heating Section, Dravo Corp, Dravo Bldg, Pittsburgh 22, Pa. 12-page bulletin No. 513 describes the Dravo "Counterflo" forced air space heater.

5 HOT GAS DEFROSTING SYSTEM—Patterson-Kelley Co, 101 Park Ave, New York 17, N. Y. 4-page bulletin No. DF-100 has simplified diagrams, in several colors, to show clearly the operation of the "Slug Eliminator" at various stages in the defrosting cycle of a typical 2-evaporator system.

6 FLAT SPRAY NOZZLES—Chain Belt Co, 1600 W Bruce St, Milwaukee 4, Wis. Bulletin No. 48-38 describes Rex flat spray nozzles in service where water or liquid chemicals are used in cleaning, cooling, washing and descaling operations.

7 AIR-MOVING EQUIPMENT—National Assn of Fan Manufacturers, 5-157 General Motors Bldg, Detroit 2, Mich. 4-page bulletin No. 108 gives functions of four specific types of fans.

8 COOLING TOWERS—Marley Co, Fairfax and Marley Rd, Kansas City 15, Kan. 4-page folder, Marley Quiz No. 3, covers questions and answers on cooling towers.

BOILERS AND AUXILIARIES

9 STEAM AND CONDENSATE RETURN SYSTEM—Planert Mfg Corp, 2256 W Walnut St, Chicago 12, Ill. 4-page booklet presents Models No. P-1 and P-2 Planert Returnal steam and condensate return system.

10 STEAM GENERATION—Commonwealth Electric & Mfg Co, 83-105 Boston St, Boston 25, Mass. Bulletin No. 10A describes Comm-O-lectric steam boilers. Bulletin No. 54 discusses Comm-O-lectric Models CA automatic electric-heated steam boilers. Bulletin No. 42A covers Comm-O-lectric Models CX automatic electric-heated steam boilers.

11 BOILER FITTINGS—Ernst Water Column & Gage Co, 250 S Livingston Ave, Livingston, N. J. 4-page bulletin No. S-2 covers gage glasses, tubing and sight glasses, gage glass guard, non-glare illuminators, etc. Bulletin No. T-1 gives specifications of Ernstlit adjustable inclined water column and high and low alarm for package boilers. 8-page bulletin No. E-1 describes and illustrates an extensive line of liquid-level and water gages for boilers.

12 AUTOMATIC OIL BURNER—Peabody Engrg Corp, 580 Fifth Ave, New York 19, N. Y. 4-page bulletin No. 400 describes the Peabody automatic oil burner. Specifications are included.

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

Example

Write here number of item in which you are interested ➡ E17

Your Company Name: Brown Mfg. Co.

Address: 3718 First Avenue, Pottsville, Okla.

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POWER, 330 West 42nd St., New York 18, N. Y.

FILL OUT AND MAIL TODAY! NOT GOOD AFTER JULY 1, 1949

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Your Name.....

Your Title.....

POWER, 330 West 42nd St., New York 18, N. Y. 4/49

13 **COAL STORAGE**—Ohio Coal Assn, 705 Rockefeller Bldg., Cleveland, Ohio. Bulletin, entitled "Storage of Coal," gives data on the preferred procedure of storing coal.

14 **REFRACTORIES**—Johns-Manville, 22 E 40th St, New York 16, N. Y. Folder, entitled "2 New Johns-Manville Refractories for Service to 3000 F." presents pertinent information on 3X Blazecrete for gunning and patching and 3X Firecrete for casting special shapes.

15 **OIL BURNERS**—Black, Sivalls & Bryson, Inc, 720 Delaware, Kansas City 6, Mo. 12-page general catalog No. 54, section 3, part 6, discusses oil burners for BS&B internal fireboxes.

16 **HIGH-TEMPERATURE MORTAR**—Ironton Fire Brick Co, Ironton, Ohio. 4-page booklet describes Ironton Alset, a high-temperature mortar, for boiler settings, incinerators, lime kilns, forging furnaces, etc.

17 **DUST COLLECTORS**—W W Sly Mfg Co, 4700 Train Ave, Cleveland 2, Ohio. 4-page bulletin No. D-491 contains photos that show a few of the many ways in which a Sly dust filter may be installed for collection of a great variety of dust and for disposal of the dust in various ways.

18 **WATER-LEVEL GAGE**—Jerguson Gage & Valve Co, 30 Fellsway, Somerville 45, Mass. Sheet gives features of the new Jerguson Trulevel gage, Unit No. 83, for accurate reading of boiler water levels.

19 **SMOKE ELIMINATION** — Delta Engrg Co, 75 E Wacker Dr, Chicago 1, Ill. 4-page folder No. 1831-A1 presents Cateleaf, a method to combat smoke evil as well as to provide a fuel saving by cleaner and more efficient combustion.

COMPRESSORS AND ACCESSORIES

20 **SINGLE- AND TWO-STAGE COMPRESSORS**—White-Roth Machine Corp, West 19th St, Lorain, Ohio. Bulletin No. P-2000 gives specifications, over-all dimensions and shipping weight of Lorain single-stage and two-stage compressors.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **WATER-COOLED AIR COMPRESSORS**—Publications Dept, Worthington Pump & Machinery Corp, Harrison, N. J. Selection chart simplifies selection of proper size compressor for average industrial use.

CONTROLS, ELECTRIC

21 **DC-AC RELAYS** — Allied Control Co, 2 East End Ave, New York 21, N. Y. Sheet No. AL-525 covers BO relays for dc and ac. Sheet No. A1-516 gives ordering specifications for BO relays.

22 **ELECTROMAGNETIC CONTROLS**—Automatic Switch Co, 391 Lakeside Ave, Orange, N. J. 16-page condensed catalog describes automatic transfer switches, remote control switches, contactors, relays, specialized controls, field discharge switches, etc.

23 **TIMING CONTROL** — Photoswitch Inc, 77 Broadway, Cambridge 42, Mass. Bulletin No. PC478 discusses Photoswitch electronic timer, Type 30HL1, for intervals from 1/20th of a second to four minutes.

24 **ROTATING REGULATOR**—Westinghouse Electric Corp, P O Box 868, Pittsburgh, Pa. 22-page booklet tells the story of the Westinghouse rotating regulator, Rototrol.

25 **FLAME FAILURE SAFEGUARD**—Combustion Control Corp, 77 Broadway, Cambridge 42, Mass. Bulletin No. CH4751 presents Fireye System FF-3 for flame failure protection of semi-automatic and manually ignited industrial oil burners.

ELECTRICAL EQUIPMENT

26 **LIGHTING FIXTURES**—Edwin F Guth Co, 2615 Washington Ave, St. Louis 3, Mo. Catalog No. 46-A gives data on Guth fluorescent and incandescent lighting equipment.

27 **SYNCHRONOUS GENERATORS** — Electric Power Dept, Elliott Co, Ridgway, Pa. 4-page bulletin No. PB 3400-1 covers construction features of Elliott high-speed, Fabri-Steel, synchronous generators.

28 **POWER TRANSFORMERS**—Pennsylvania Transformer Co, Box 6304, Pittsburgh 12, Pa. 4-page pamphlet, written by W R Swoish, Pennsylvania's sales manager, describes Standard Parts power transformers.

29 **MOTOR BASE** — Automatic Motor Base Co, Box 2186, Paterson, N. J. 4-page bulletin No. 492-A discusses the Automatic motor base for motors from 1/6 to 100 hp.

30 **INDUCTION MOTORS** — Electric Power Dept, Elliott Co, Ridgway, Pa. 4-page bulletin No. PB7000-1 gives construction details of 250 to 3500-hp Fabri-steel induction motors.

31 **ELECTRICAL CONTACT RIVETS**—Gibson Electric Co, 3350 Frankstown Ave, Pittsburgh 31, Pa. 6-page catalog No. C-12 describes electrical contact materials in which the contact rivets are furnished, as well as the standard sizes of the flat, crowned and pointed contact rivets.

INSULATION, HEAT, COLD AND VIBRATION

32 **INSULATION ADHESIVES**—Benjamin Foster Co, 4636 W Girard Ave, Philadelphia 31, Pa. 16-page manual covers sealers, surface coatings, cements, mastics, emulsions and other adhesives for use with various types of insulation in both industrial and marine applications.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **INSULATION VALUES**—Silvercote Products, Inc, 161 E Erie St, Chicago 11, Ill. 108-page booklet includes both winter and summer insulation values, technically known as "U" values.

(*Continued on page* 198)

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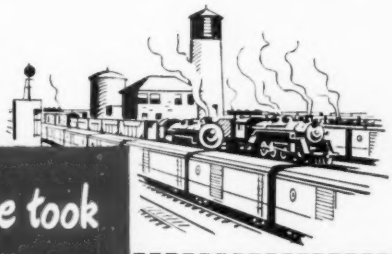

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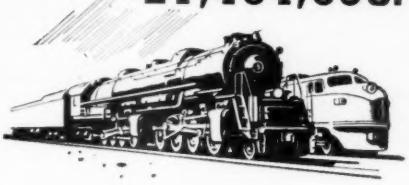

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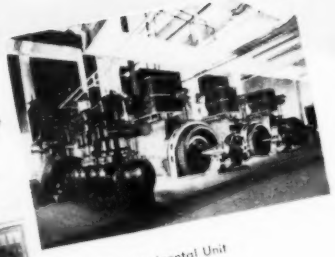
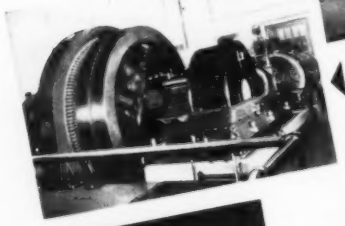
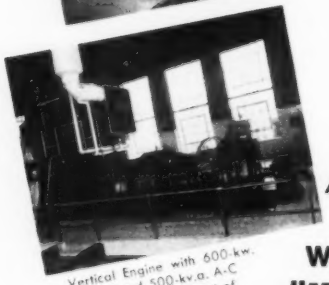


One 750-kv.a. and Two 375-kv.a. Vertical Units in Brewery

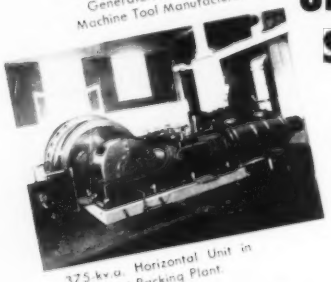


1000-kv.a. Horizontal Unit in Furniture Factory

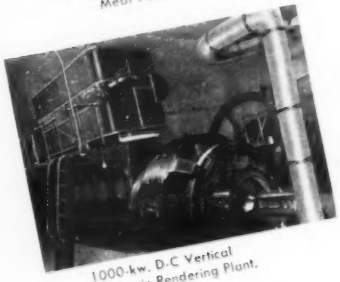


Vertical Engine with 600-kw. D-C and 500-kv.a. A-C Generators in Plant of Machine Tool Manufacturer

Why buy **electric power when you can** *generate it more economically* **with SKINNER "Universal Unaflow" STEAM ENGINES**



375-kv.a. Horizontal Unit in Meat Packing Plant



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Thousands of manufacturers in practically every known industry, and operators of various types of institutions, like the owners of the power plants shown here, have found it more economical to generate their own electric power with Skinner "Universal Unaflow" Steam Engines than to purchase it from the local utility.

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For Over 80 Years, Doing One Thing Well—Building Steam Engines

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33 LINER—M. H. Detrick Co, 111 W Washington St, Chicago 2, Ill. 4-page bulletin shows construction details of Insuliner, a new liner for hot ducts.

34 ROOF INSULATION—Johns-Manville, 22 E 40th St, New York 16 N. Y. 4-page brochure gives advantages of rock cork felt-sided roof insulation. This booklet contains conductivity data.

MAINTENANCE AND SAFETY EQUIPMENT

35 WELDING HELMET—Mine Safety Appliances Co, Braddock, Thomas and Meade St, Pittsburgh 8, Pa. Bulletin No. CO-2 describes the new MSA combination Skullgard-welding helmet.

36 HYDRAULIC VISES—Columbian Vise & Mfg Co, 9017 Bessemer Ave, Cleveland 4, Ohio. 4-page booklet No. HV7548-R discusses operation of Columbian hydraulic vises.

37 FLEXIBLE SHAFTING—Elliott Mfg Co, 350 State St, Binghamton, N. Y. 16-page catalog No. 49 covers Elliott flexible shafting. Photos, charts and tables are included.

38 VACUUM CLEANERS—Breuer Electric Mfg Co, 5100 Ravenswood Ave, Chicago 40, Ill. 4-page folder presents Breuer Tornado industrial vacuum cleaners.

39 OIL INSPECTION KIT—Gerin Corp, P O Drawer 653, Red Bank, N. J. 4-page circular No. 300 discusses the Gerin oil inspection kit for a quick and simple way for determining actual condition of your lubricating oil.

MAINTENANCE MATERIALS

40 TANK LINING—Apex Engrg Co, 75 E Wacker Dr, Chicago 1, Ill. 4-page folder describes Apex Porceline tank lining for any shape tanks. 4-page leaflet includes photos and tables of Apex tank lining.

41 SOFT SOLDER ALLOYS—Technical Dept, Kester Solder Co, 4201 Wrightwood Ave, Chicago 39, Ill. 28-page technical manual, entitled "Solder and Soldering Technique," gives a complete analysis of properties and applications of soft solder alloys and soldering fluxes.

21 PLANNED PAINTING—Valdura Div, American-Marietta Co, 43 E Ohio St, Chicago 11, Ill. 12-page booklet, "Plan Before You Paint Your Plant," presents advantages of planned painting.

43 ANTI-RUST PAINT—Speco, Inc, 7308 Associate Ave, Cleveland 9, Ohio. Bulletin describes Rustrem anti-rust paint and other Rem paint products. This bulletin lists complete instructions for use of Rustrem.

44 PROTECTIVE COATING—Dampney Co of America, Hyde Park, Boston 36, Mass. 4-page bulletin No. 1540 covers pertinent data on Apexior No. 3 and its application to drinking and other water storage tanks, refrigerant condensers, various types of air-conditioning equipment, etc.

45 THERMOSETTING RESINS—Carboline Co, 7603 Forsythe Blvd, St. Louis 5, Mo. 4-page bulletin No. C-2 tells how to repair and protect metal equipment for corrosive service with five new thermosetting resins.

MATERIALS HANDLING

46 PERMANENT MAGNETIC PULLEYS—Stearns Magnetic Mfg Co, Milwaukee 4, Wis. Bulletin No. 350 contains features, illustrations, specifications, dimensions, capacities and typical applications of new line of permanent magnetic pulleys.

47 ELECTRIC HOISTS—Wright Hoist Div, American Chain & Cable Co, York, Pa. 6-page folder No. DH-65 describes new advanced design line of Wright Speedway electric hoists.

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A piece of burned alloy piping is just as useless as a burned roast.

Excessive grain growth, heat shock, cracking, local wall thinning, or local deformation, and excessive surface oxidation are some of the harmful results of improper heating of alloy piping. Procedures that are scientifically correct . . . careful control of furnace and fuel . . . sound judgment and experience . . . all are needed to avoid improper heating.

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48 LIFT TRUCKS — Barrett-Cravens Co, 4609 S Western Blvd, Chicago 9, Ill. 28-page bulletin No. 4883 discusses hand lift trucks in capacities from 1000 to 15,000 lb.

49 COAL-HANDLING SCRAPER — R G LeTourneau Inc, Peoria, Ill. Broadside No. TP-189 presents the new D Roadster Tournapull for stockpiling coal.

50 CRANES AND MONORAILS — Whiting Corp, Harvey, Ill. 8-page bulletin No. M-11 covers Whiting Tram-beam overhead materials-handling systems.

MECHANICAL TRANSMISSION

51 V-BELT DRIVES — Mechanical Goods Div, United States Rubber Co, Rockefeller Center, New York 20, N. Y. 100-page manual contains a comprehensive set of drive tables for multiple belts; complete sheave data including construction, dimensions, and weights; complete fractional hp drive layouts; comparison tables with information on quarter turn drives and hexagon double V-drives.

52 HYDRAULIC ELECTRIC POWER UNITS — American Blower Corp, Detroit 32, Mich. 4-page bulletin No. 8519 presents the new Gyrol fluid drive hydraulic electric power units.

METALS AND ALLOYS

53 STEEL PRODUCTION—Room 1271, Inland Steel Co, 38 S Dearborn St, Chicago 3, Ill. Booklet begins with a brief historical outline of steelmaking and then describes the many phases of modern steel production.

54 HIGH-SPEED STEELS — Jessop Steel Co, Washington, Pa. 12-page catalog describes the analyses, heat treatments and applications of five most commonly used types of high-speed steels.

55 PUMP METALS — International Nickel Co, 67 Wall St, New York 5, N. Y. Booklet, entitled "How to Get Longer Service From Your Pumps," contains eight illustrated pages in which four factors that affect pump life and performance are discussed.

56 GALVANIC CELL CORROSION—International Nickel Co, 67 Wall St, New York 5, N. Y. 8-page booklet gives reasons for galvanic cell corrosion, as well as methods for helping to overcome it.

57 METAL QUALITY—Drop Forging Assn, 605 Hanna Bldg., Cleveland 15, Ohio. 60-page booklet describes and illustrates development of metal quality progressively throughout hot working operations, from the blast furnace to the finished forging.

METERS AND INSTRUMENTS, ELECTRIC

58 TRANSFORMER TURN RATIO TEST SET—James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa. 8-page bulletin No. 55 covers a new instrument for measuring turn ratio in power transformers.

59 MEGOHMER INSULATION TESTER—Herman H Sticht Co, 27 Park Pl, New York 7, N. Y. 4-page bulletin No. 455 describes construction of new Megohmer insulation tester.

60 MEASUREMENT AND CONTROL INSTRUMENTS—Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa. 42-page catalog No. ND46(1) discusses complete line of Speedomax indicators, recorders and controllers.

PIPING, FITTINGS, VALVES AND SPECIALTIES

61 WELDING FITTINGS—Globe Steel Tubes Co, Milwaukee 4, Wis. Catalog No. 501 describes Globe welding fittings. Photos, diagrams and tables are included.

We're not METHUSELAH*
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Since 1899, we have been piping contractors of carbon or alloy steel piping in power and process plants. During these 50 years we have "kept pace" with engineering advances in the use of high temperatures and high pressures for power plant equipment. We have built the organization, shop facilities and experience to relieve you of all piping details from preliminary engineering to final completion. Our satisfaction in knowing that a job has been "well done" comes from our repeat contracts from some of the country's largest utilities and industrial plants. For your next piping job, rely on this 50-year record of experience and achievement. When you are making your piping plans, also ask us about the Mitchell-Westport Joint which prevents weld metal protrusions inside the pipe without using backing rings. Write now for our bulletin, "Something New in Welding."

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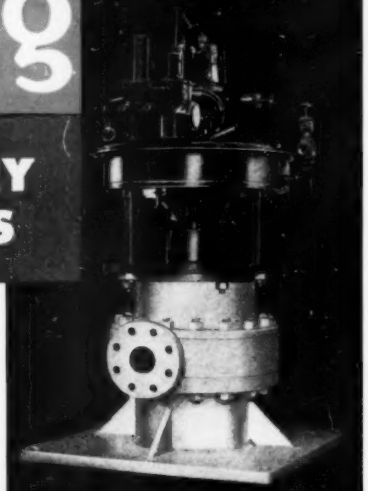

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Write for turbine bulletin or for specific details.

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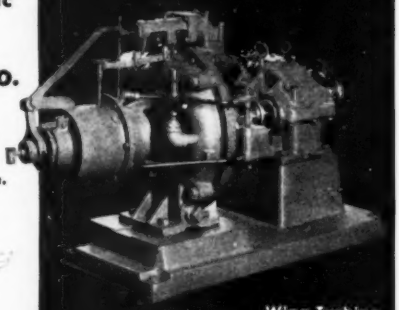

Wing Turbine and Gear Combination on common pedestal base

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New York 11, N. Y.
Factories: Newark, N. J. • Montreal, Can.

62 STEAM TRAPS — V D Anderson Co, 1935 W 96th St, Cleveland 2, Ohio. 32-page booklet, entitled "Solving Steam Trap Problems," contains detailed data for selecting right size trap.

63 EXPANSION JOINTS — Magnilastic Div, Cook Electric Co, Chicago 14, Ill. 12-page condensed catalog No. 200-R covers ASCO solenoid valves for automatic and remote control of flow of liquids and gases.

64 STEAM SEPARATORS — Wright-Austin Co, 315 W Woodbridge St, Detroit 26, Mich. Catalog contains descriptive data on 29 different types of steam separators that are furnished in a total of more than 145 sizes in the pipe size range of 1-2 to 16 in. Chart enables anyone familiar with charts and tables to quickly select most efficient size and type of steam separator for a specific installation and determine pressure drop through the separator.

65 SOLENOID VALVES — Automatic Switch Co, 41 E 11th St, New York 3, N. Y. 12-page condensed catalog No. 200-R describes ASCO solenoid valves for automatic and remote control of flow of liquids and gases.

66 STEEL TUBING—Babcock & Wilcox Tube Co, Beaver Falls, Pa. Company has available latest editions of five tables on steel tubing.

67 INDUSTRIAL FITTINGS—Thomas Laughlin Co, Portland, Me. Catalog lists complete line of drop-forged wire rope and chain fittings. Tables and charts are included.

PRIME MOVERS AND ACCESSORIES

68 BALL - CHECK INDICATOR — CookCo Engrg Co, 1737 Howard Ave, Chicago 26, Ill. Leaflet No. 602c describes CookCo ball-check indicator for testing diesel cylinder pressures.

69 DIESEL ENGINES—Nordberg Mfg Co, Milwaukee 7, Wis. 8-page bulletin No. 163 presents Nordberg diesel engines, Type DR-24, for stationary and marine service for Duafuel or oil burning operation, supercharged and non-supercharged.

PUMPS

70 MULTISTAGE PUMPS—Pump Div, Byron Jackson Co, Terminal Annex Box 2017, Los Angeles 54, Calif. 16-page bulletin No. 48-4000 describes lines of SK and SLO Multiplex pumps.

71 CENTRIFUGAL PUMPS — Marlow Pumps, Ridgewood, N. J. 12-page bulletin No. PM48 discusses Marlow self-priming centrifugal pumps for transfer pumping and for fueling service.

72 BOILER FEED PUMPS — Worthington Pump and Machinery Corp, Harrison, N. J. Bulletin No. W-318-B7E contains all data and specifications of four new boiler feed pump sizes to centrifugal pump line.

73 CENTRIFUGAL PUMPS — Rice Pump & Machine Co., Milwaukee, Wis. Bulletin describes and illustrates Models 7M and 10M Rice self-priming centrifugal pumps.

WATER TREATMENT

74 WATER DEMINERALIZER—A E Tomkin & Co, 1828 Columbia, Rd, N W, Washington 9, D. C. 8-page folder describes Hydrion water demineralizer. Specifications are included.

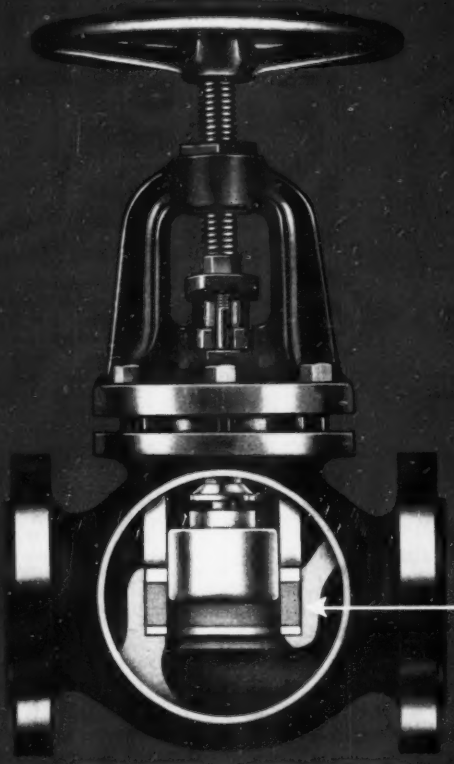
75 SCALE CONTROL SYSTEM—Apex Engrg Co, 75 E Wacker Dr, Chicago 1, Ill. 4-page booklet presents Akwatrol, a combination electrical-chemical method for controlling scale in heat-exchanger equipment.

76 SCALE CONTROL CHEMICALS—Wright Chemical Corp, 627 W Lake St, Chicago 6, Ill. 8-page bulletin covers water conditioning, scale control and corrosion inhibition, and recommends chemicals for particular applications.

Strahman

SEATLESS PISTON VALVES

A RADICAL DEPARTURE IN CLOSURE PRINCIPLE



Force is never necessary to close a Strahman Valve.

The long sealing surface gives positive shut off.

No metal to metal contact is involved — hence no expansion or contraction problems.

Positive closure assures prolonged life of equipment which the valves control.

Suitable for low and high temperature range of minus 125° F. to plus 750° F.

The Ring (usually made of laminated sheets of compressed asbestos) is available in materials suitable for hard-to-hold liquids or gases.

The ring may be further compressed against the piston by a take-up on the bonnet, while the valve is in service. The ring is easily replaced when necessary.

The HEART of the STRAHMAN VALVE

A MOST POSITIVE CLOSURE PRINCIPLE

The stainless steel piston is shown entering the ring (partly closed), just as a cork seals a bottle.

Made in Cast Bronze, Steel and Iron. Screw ⅛" to 2½" Globe and Angle. Flange 1" to 10" Globe and 1" to 4" Angle.

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for small drainage jobs . . .

A NEW *SMALL* TRAP WITH *BIG* TRAP QUALITY FEATURES!

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• Renewable seat—easily removed for servicing.
• Strong's patented, wear-resistant Anum-Metl† valve and seat—guaranteed leak-proof for one year. Scientifically designed Hi-Cap* orifice gives greater capacity.
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• Seamless, deep drawn, stainless 18-8 bucket—no welds.
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Available for pressures from 0 to 150 p.s.i., the Strong* No. 070 fits all standard trap applications. Built especially for use on laundry, restaurant and hospital equipment and in industry wherever small drainage is a problem.

As with all Strong Semi-Steel Traps, the 070 is guaranteed against defects in material and workmanship for one year. Write today *for more complete information.*

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Reducing Valve | Blast Trap | Strainer

STRONG

OTHER EQUIPMENT

77 VARIOUS EQUIPMENT — Black, Sivalls & Bryson, Inc, 720 Delaware, Kansas City 6, Mo. 54-page condensed general catalog discusses oil and gas separators, emulsion treaters, indirect heaters, tubular heaters, volume type heaters, internal firebox heaters, bolted tanks, vent valves, etc.

78 SUPERVISORY ANNUNCIATORS —Auth Electric Co, 34-20 45th St, Long Island City 1, N. Y. 8-page bulletin No. 120 covers Auth supervisory annunciators. Photos are included.

79 HEATING ELEMENTS — Davis Engrg Corp, 1064 E Grand St, Elizabeth 4, N. J. 8-page bulletin No. 20 gives capacity and dimension tables for tube elements. Full instructions for installation of Paracoil heating elements are shown.

80 DYNAMOMETER—W C Dillon & Co, 5410 W Harrison St, Chicago 44, Ill. 4-page bulletin D discusses construction of the Dillon dynamometer.

81 STAINLESS-STEEL ELECTRODE —Lincoln Electric Co, Cleveland 1, Ohio. 8-page bulletin No. 463 discusses Lincoln electrodes for shielded arc welding of stainless steels and for surfacing with dc.

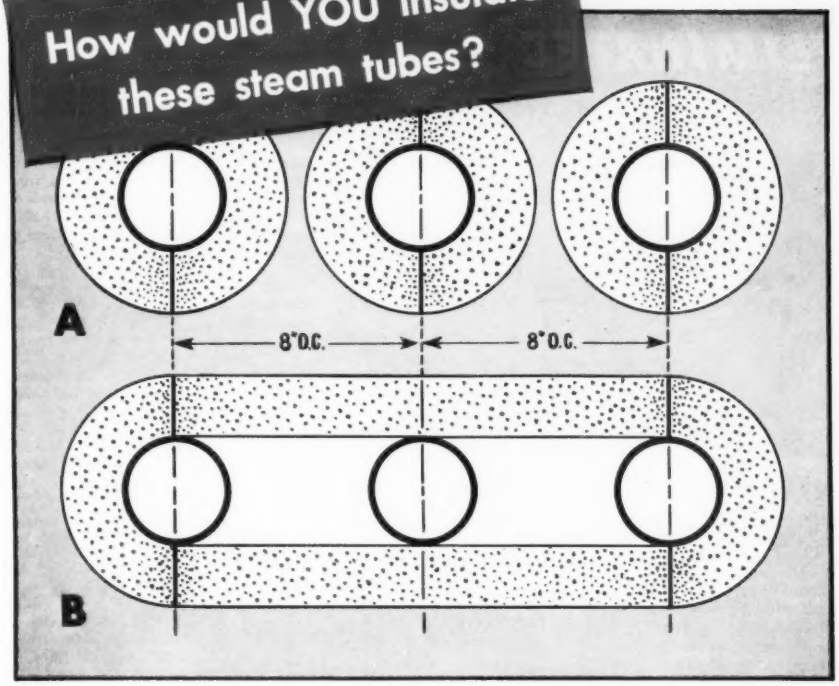
More Hydroelectric Power for Scotland

Second largest hydroelectric power project of the North Scotland Hydro-Electric Board has been approved by Parliament. Known as the Glascarnoch-Luichart-Torr Achiltg development, it involves the building of eight dams and four power-generating stations with a combined capacity of 60,000 kw. A 5-mile tunnel will lead the water to the Glascarnoch plant where 24,000-kw capacity will be installed. This is the largest plant in the undertaking.

Lt Gen Raymond A Wheeler retired as chief of Army Engineers on March 1. Maj Gen Lewis A Pick, the Army's div engineer for Missouri River and co-author of Pick-Sloan plan for joint Army-Reclamation Bureau development of the Missouri Basin, is his successor. Gen Wheeler has accepted post of chief engineer for International Bank for Reconstruction and Development. This was the position he was slated for last June when the President refused to accept his resignation as chief of Engineers. Gen Wheeler agreed at that time to remain with the Engineers until his successor had been chosen.

Robert C Stanley, chairman of board of directors of International Nickel Co of Canada, Ltd, has announced that on his recommendation the Board, at its meeting today, has made the following executive rearrangements in the company: (1) Stanley, president since 1922, director since 1917, and chairman and president since 1937, continues as chairman of the board. (2) Dr John F Thompson, executive vice-president since 1936, and a director and member of executive committee since 1931, has become president. (3) Dr Paul D Merica, vice-president since 1936, and a director, has become executive vice-president. (4) Henry S Wingate, secretary since 1939, and a director, has become a vice-president and continues as secretary. There was no change among the other officers of the company.

How would YOU insulate these steam tubes?



These 3½" downtake tubes connecting the lower drum with the bottom waterwall headers operate at 375° F. Specifications call for 2" of 85% Magnesia insulation with sewed canvas finish. Would you insulate each pipe individually, as shown at A, or would you box them in with half sections of pipe covering on the ends, and block insulation between, as shown at B?

HERE'S WHAT THE ARMSTRONG ENGINEER RECOMMENDED:

In this case the Armstrong Engineer recommended Method B. His calculations showed that from a material and labor cost standpoint it would be less expensive to insulate the three tubes as one unit. Method B also cuts down the amount of insulation surface from which heat is lost by radiation. As there is practically no maintenance on tubes of this kind, the fact that Method A allows for easier access for repair work did not have to be considered.

Had the tubes been spaced several inches farther apart, or if maintenance had been a problem, then Method A would have been the most practical to use.

Often, the dividing line between two methods of solving a certain insulation problem is pretty finely drawn. When these cases present themselves, Armstrong engineers take pride in their ability to arrive at a specification which will provide the best job. If you consult the Armstrong Office nearest you before planning your next insulation job, they will be glad to offer you their thinking on any problems you may have. Their solutions can often save you time and money.

FREE BOOKLET

Write today for your free copy of the 28-page booklet, "Armstrong's Industrial Insulations." This booklet contains specifications for application of both heat and low-temperature insulations and an insulation chart listing types and thicknesses of insulation for all temperatures. Write to Armstrong Cork Company, Industrial Insulation Dept., 7004 Maple Ave., Lancaster, Pennsylvania.

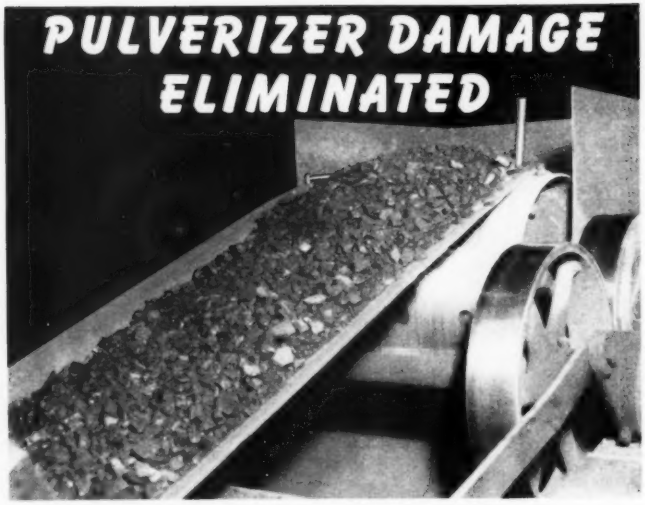
ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero

To 2800° Fahrenheit

PULVERIZER DAMAGE ELIMINATED

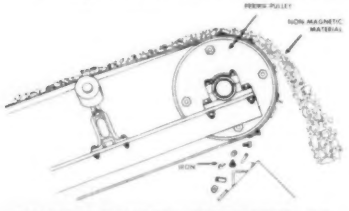


with NEW Dings Alnico Magnet PERMA-PULLEY

MILL outage has been substantially reduced at Interstate Power Company's Dubuque, Iowa, plant with the powerful Alnico Magnetic PERMA-PULLEY illustrated above. This unit automatically removes and discharges up to 25 lbs of tramp iron daily from 20 tons of coal per hour, traveling at a belt speed of 255 fpm. Eliminates human failure—saves labor—saves time! Mr. C. G. Robinson, Chief Engineer, says, "Since installing the Perma-Pulley our mill outage and maintenance has been less than with the magnet it replaced which let iron get by."

Plan now to install an efficient permanent Dings PERMA-PULLEY on *your* coal handling equipment for constant unattended protection. Not affected by weather conditions. Ruggedly built for a lifetime of efficient separation. Available in 12" to 60" face widths, 8" to 48" diameters. For complete data on permanent and electromagnetic pulleys, send for your copy of Catalogs C-1007A and C-1001A TODAY.

- Magnetic Strength Guaranteed for Mechanical Life of the Installation!
- Highest Separation Efficiency
- Constant Magnetic Protection
- No Electrical Accessory Expense
- Pays for Itself
- No Operating Cost
- No Maintenance
- Highest Grade Alnico Magnet
- Equal Magnetic Strength Across Full Belt Width



PERMA-PULLEY

When tramp iron reaches the PERMA-PULLEY it is held to the underside of the belt until it passes beyond the magnetic field, where it is discharged.

DINGS MAGNETIC SEPARATOR CO.
4765 W. Electric Ave., Milwaukee 14, Wis.

Dings
"HIGH INTENSITY"

MAGNETIC PERMANENCE GUARANTEED *for the Mechanical Life of the Installation!*

APPOINTMENTS

Combustion Engineering — Superheater Inc promotes Paul Waller to district manager of its Minneapolis office. Also, Claude Klimas is assistant to the manager of industrial div in New York City, in charge of sales. Charles Lehrbach succeeds Klimas as contract salesman in the Boston office.

Riley Stoker Corp, Worcester, Mass., announces elevation of F H Daniels from president to chairman of the board of directors, and promotion of L E Griffith from vice-president and general manager to president and general manager.

George H Kent, now director of sales for **E F Drew & Co,** New York City, will be responsible for coordination of all sales activities of the firm's operating divisions.

De Laval Steam Turbine Co, Trenton, N. J., reports appointment of Walter Rahel as advertising manager.

Henry G Harley and Elliot A Baines have joined the sales force of **Alloy Steel Products Co,** Linden, N. J., as sales representatives, and are assigned to the New York area.

Monsanto Chemical Co, St. Louis, Mo., names William T Nichols director of the firm's general engineering dept.

The heavy machinery div of **Nordberg Mfg Co,** Milwaukee, Wis., opens a combination sales and service office at 527 City Park Ave, New Orleans, La. W J Moran is district manager with H F Wagner assisting as sales and service engineer. In marine dept, John Kuehn is made superintendent of service.

Northern Equipment Co, Erie, Pa., announces the following personnel changes: Harold A Schlieder resigned as chief engineer to open his own office as sales and service representative in upper New York State. He is located at 520 Robineau Rd, Syracuse, N.Y. Francis W Bunting is named chief engineer in charge of all sales and service engineering. Harry W Weining assumes charge of all production engineering in addition to his other duties as director of research.

Quentin Graham has been elected a vice-president of **Elliott Co,** Jeannette, Pa.

Taylor Forge & Pipe Works, Chicago, designates R W (Pat) Murphey advertising manager.

Air Reduction Co, New York City, names Dr G V Slottman director of research and engineering for the company.

Several changes are announced for **Brown Instruments** div of Minneapolis-Honeywell Regulator Co in its various branches as follows: O B Wilson is manager of sales for east, southeast and central regions supervising sales in the area extending from Florida and the Gulf of Mexico to the Canadian border. He makes his headquarters at the Brown plant in Philadelphia. Warren W Matlack succeeds Wilson

GULFCREST OIL

selected for two more big turbine units . . .

168,750 kW Each!

Two new 168,750 kw turbo-generators recently installed at the Philadelphia Electric Company's Southwark Electric Generating Station at Philadelphia, Pa., get the right start for a long life—with Gulfcrest oil.

Two more big turbines get the safe, sure, long lasting protection of Gulfcrest, the world's finest turbine oil!

The selection of Gulfcrest for these two new turbines, among the largest in the world, was the result of outstanding operating experience with this great oil.

Extra refining is the important reason for this performance record! Gulfcrest Oil is not only refined by conventional methods, but is superrefined by Gulf's exclusive Alchlor Process.

This extra step removes as much as 15% of conventionally refined oil—the 15% that contains the hydrocarbons most apt to oxidize and form sludge, emulsifiers and harmful acids. Write for your copy of the booklet "Gulfcrest Oil for Steam Turbine Lubrication."

Gulf Oil Corporation · Gulf Refining Company

Division Sales Offices:

Boston · New York · Philadelphia · Pittsburgh · Atlanta
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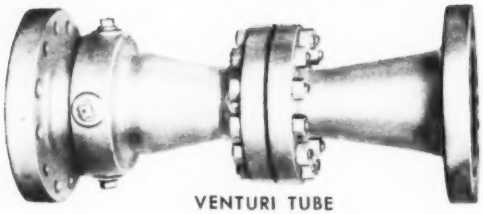
GULF INDUSTRIAL LUBRICATION

MEASURE FLOWS WITH *GREAT* ACCURACY!



VENTURI TUBE

The correct design and careful workmanship of Simplex Venturi Tubes insure stable coefficients over wide velocity ranges, enabling the accompanying meter to measure flow with extreme accuracy. The high efficiency in the utilization of the differential pressure head is the result of more than 40 years of manufacture and research by this company.

Simplex Type MO Meters, when used in conjunction with Simplex Venturi Tubes as primary devices, guarantee the utmost accuracy in flow measurement over long ranges. They can be furnished to measure accurately over ranges of 20 to 1, 25 to 1, 28.5 to 1 or 32.5 to 1.

Where flow ranges are long, a single meter often will be sufficient where two or more ordinary instruments would otherwise be required.

MO METER

For full information and bulletins, write to the Simplex Valve & Meter Company, 6780 Upland Street, Philadelphia 42, Pa.

SIMPLEX

VALVE AND METER COMPANY

as industrial manager of New York City branch, and Devon W Fryback replaces Matlack as district manager of the Albany N. Y. office. D Lyle Russell is transferred from Boston office and succeeds Fryback in Hartford, Conn., as industrial manager. The East Orange, N. J., sales headquarters is now a district office with Herman Hoyler as industrial manager.

Bryce B Curry is engaged by **Manning, Maxwell & Moore Inc,** as a field specialist for Hancock valves manufactured in the company's Watertown, Mass., plant. Curry will make headquarters in the Houston, Texas, district office, and his activities will cover the Gulf Coast area. Also, Henry S Moore is now director of engineering and development for the Consolidated-Ashcroft-Hancock divisions of the company.

Superior Electric Co's West Coast representative, J C van Groos, has moved into new quarters at 1436 North Serrano Ave, Hollywood, Calif.

Seward T Salvage becomes sales promotion manager of **Timken Roller Bearing Co,** Canton, Ohio. His headquarters is now in the home office. T F Rose fills vacancy caused by death of C E Webster who had been manager of Timken Roller Bearing Service and Sales Ltd, Toronto, Ont., Canadian subsidiary. H C Telford succeeds Rose as manager of the company's Cincinnati branch.

Globe Products Mfg Co, Los Angeles, Calif., elects W B Merriam president of the firm, and R E Lockard, vice-president in charge of sales. Thomas O H McArdle is selected to head contract div.

A branch office and warehouse has been established by **Ward Leonard Electric Co** at 420 South San Pedro St, Los Angeles, Calif., with H S Eales as district manager, and E R Slivinsky assisting.

Westinghouse Electric Corp announces appointment of three men to important positions in its new Atomic Power div. The men are Philip N Ross, assistant director of research; E L Kuno, assistant to div manager; and L C Mechling Jr, works engineer. This div will carry out construction and testing of a nuclear reactor—atomic power plant—for naval ship propulsion under terms of a contract awarded by the Atomic Energy Commission.

Other changes in **Westinghouse** are as follows: In transformer div at Sharon, Pa., Robert J Seybold is named assistant purchasing agent and C H Bartlett becomes manager of power transformer sales. William C Hipple retires after managing the Trenton, N. J., plant of the company's lamp div for 30 years. Industrial electronics div manager, C J Burnside resigns to organize an independent industrial consultant service with headquarters in Baltimore. He continues his association with Westinghouse as a consultant.

Paul J Breden has assumed duties of J Edwin Conaway, who died Dec 14, as southern district manager for **New York Belting and Packing Co.** Breden's head-

EXIDE BATTERIES

for peak performance in Diesel engine cranking

You can always count on Exide Batteries for ample power and peak performance in Diesel engine cranking. That's because they're designed and built specially for the job . . . by engineers who for many years have been closely associated with the problems of Diesel engine starting.

The extra capacity, rugged construction and trustworthy service of Exide Diesel Cranking Batteries are proved daily in every field—on trucks, buses and off-the-highway equipment . . . in ships and railway locomotives . . . in power plants. For dependability, long life and low cost maintenance, choose Exide Batteries for all your battery cranking.

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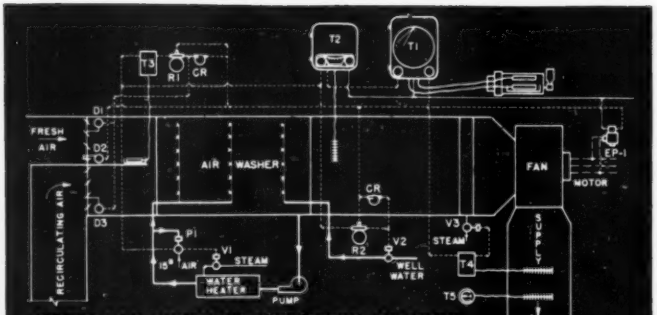
THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • *Exide Batteries of Canada, Limited,* **Toronto**



100,000 C.F.M. CENTRAL AIR CONDITIONING FAN SYSTEM
REGULATED BY POWERS CONTROL AT UXBRIDGE WORSTED CO.

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AIR CONDITIONING CONTROL

with year 'round accuracy of 1°F. plus or minus regulates over 300,000 C.F.M. at—

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(T-1) POWERS WET AND DRY BULB RECORDING-CONTROLLING PSYCHROMETERS at Uxbridge Worsted Mill regulate—

One 100,000 C.F.M. fan system
" 80,000 " " "
" 12,000 " " "
Two 60,000 " " "

(T-2) POWERS INDICATING SUB-MASTER DEWPOINT REGULATORS automatically control the air washers

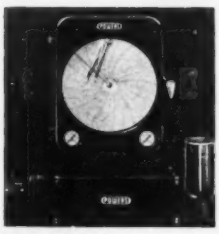
POWERS dampers, valves, relays and other devices are used with T-1 and T-2 to obtain the accurate control mentioned above.

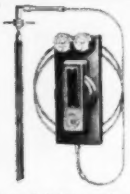
20 to 30% Increase in Efficiency—claimed for modern air conditioning installed in carding, spinning, winding, weaving and sewing departments in Uxbridge, Mass., Mill. Dry bulb temperature of 78° F. and Wet bulb at 68° F.—accurately maintained at all times by POWERS control—helps produce a better product at lower cost.

For Better Air Conditioning Control and valuable aid in selecting the right equipment for your requirements contact our nearest office: BOSTON, 125 St. Botolph St.—NEW YORK, 231 E. 46th St.—PHILADELPHIA, 2240 N. Broad St.—GREENSBORO, N. C., Jefferson Standard Bldg.—ATLANTA, 142 Spring St.—Also BIRMINGHAM and NASHVILLE. (ACU)

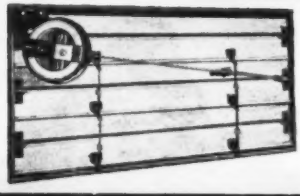
A FEW OF THE MANY DIFFERENT TYPES OF POWERS CONTROLS

Above: T-2 Powers Series 100 Sub-master Dewpoint Indicating Regulator.
At Right: Powers Series 100 Wet and Dry Bulb Recording-Controlling Psychrometer.
Below: D-1-2-3 Powers Louvre Damper.





Above: T-3-4 Powers Type K Remote Bulb Thermostat.
Below: T-5 Powers Remote Bulb Dial Indicating Thermometer.



V-1-2-3 Powers Diaphragm Valve

THE POWERS REGULATOR CO.
OFFICES IN 50 CITIES • SEE YOUR PHONE BOOK
Over 55 Years of Temperature and Humidity Control

quarters are in Dallas, Texas, and he will have under his jurisdiction all states from the Atlantic coast to the western border of Texas and as far north as southern Illinois. Also, C A Franklin Jr has been made district manager in the Rocky Mountain area, covering all of Montana, Nevada, eastern Idaho, Utah, Wyoming, Colorado, New Mexico and Arizona.

Appointment of Andre S Rubin Jr as sales manager has been announced by **Marlow Pumps,** Ridgewood, N. J.

Pittsburgh Steel Co names K H Bender sales manager of tube specialties of the mid-continent district with headquarters in Tulsa, Okla., office. T R Miller is assistant sales manager.

Pennsylvania Flexible Metallic Tubing Co, Philadelphia, promotes James R Derrick to assistant sales manager.

W R Hendrey Co, Smith Tower, Seattle, Wash., is chosen as territorial representative for **Marcus Transformer Co.** Hendrey will handle states of Washington and Oregon.

Syntron Co, Homer City, Pa., has announced the following changes: George L Chedsey has been appointed supervisor of mining equipment and works out of the firm's main office. E J McIlvaine and A C Staley Jr have become junior salesmen in vibratory material handling div of St. Louis and Cleveland offices, respectively. John C Mitchell and F J Kirby Jr have taken over power tool sales in the Boston and Cleveland offices, respectively. Also, Philadelphia branch office has moved to 1018-20 W Lehigh Ave, Phila., and location of offices in Kansas City, Mo., has been changed to the Wirthman Bldg.

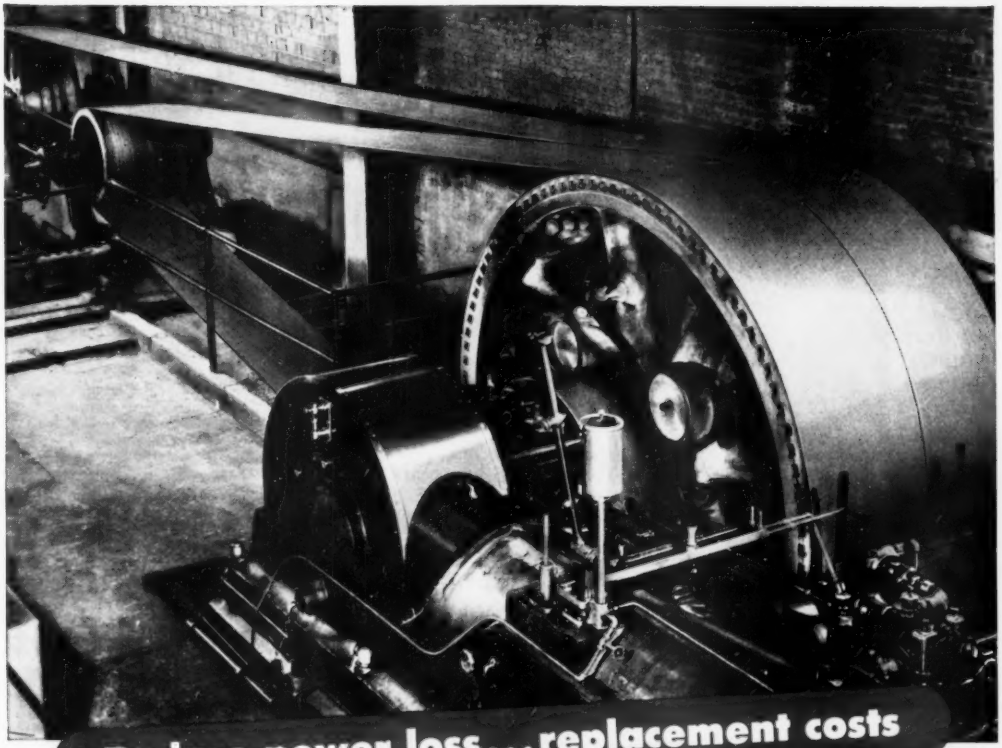
Carl E Haugh is now district sales manager for **Hydropress Inc,** in its Eastern and Mid-Western divisions.

Perfex Corp, Milwaukee, names Allen Butler assistant to the president, while V P Black, newly made vice-president, fills vacancy left by Butler, as manager of controls div.

Dr A Paul Thompson becomes director of research for **Eagle-Picher Co,** Cincinnati, Ohio, filling position left vacant by death of Earle W McMullen. Dr Thompson will direct the extensive research activities of the company from its main laboratory at Joplin, Mo. Clyde B Lynde assumes duties as vice-president and general manager of insulation div at the firm's executive offices in Cincinnati.

Gits Brothers Mfg Co, Chicago, appoints Frank A Kovarik, general sales manager, to establish and manage Michigan branch office in Ludington where operations will be supervised for the entire state of Michigan.

A series of promotions and changes in sales div of **Fairbanks, Morse & Co** are as follow: O O Lewis is now sales manager and is succeeded by Harry L Hilleary as assistant sales manager. Both are at the company's headquarters in Chicago. L A



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You won't waste power through belt slippage. And you can depend on the belt for full power even when operating at peak capacity.

This famous, extra high quality belting is made by Hewitt to assure maximum power delivery from drive pulley to driven pulley. You will find that it is especially adaptable for your power transmission operations where severe flexing—due to small pulleys, high speeds, and short centers—is encountered.

Monarch straight-edge Amber Transmission Belting is made of only premium-grade, hard (silver) duck. All plies are embedded—completely insulated with highest quality pure gum rubber compounds—to give you the advantages of greater freedom from stretch. It resists moisture, mildew, grit.

For maximum performance use Monarch Amber Transmission Belting wherever there are heavy shock loads or abuse conditions—in pulp and paper mills, saw mills, mines, stone crushing plants, oil fields, quarries, and other severe transmission operations.

Phone your Hewitt distributor for further details on this unusual new belting. He's listed in the yellow pages of your telephone directory. Or write Hewitt Rubber Division, 240 Kensington Avenue, Buffalo 5, N. Y. No obligation, of course!

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Why Hewitt Monarch Amber Transmission Belting Meets Your Needs

1. Made of highest quality gum rubber compounds and premium-grade, hard (silver) duck.

2. All plies straight-laid under uniform tension to insure even stresses throughout the belting.

3. Remarkably flexible and free from stretch because plies are completely insulated with pure gum rubber compounds.

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Weom is transferred to St. Louis to become branch house manager, replacing Hilleary. Donald T Johnstone, in turn, succeeds Weom as manager of the corporation's pump div with offices in Chicago. Also, Louis R Gaiennie joins the firm as director of personnel and makes headquarters at the Beloit, Wis., plant of the company.

Allis-Chalmers Mfg Co names Frank H Stohr general manager of its Norwood works. He succeeds R W Davis who will continue in an advisory capacity to the general manager. New appointments in the organization's steam turbine dept are C A Robertson, engineer-in-charge of test and engineering calculations groups, engineering section, and W F Dueringer, supervisor of service engineering, sales section.

A St. Louis, Mo., office has been established by **Chain Belt Co** at 8001 Clayton Rd under direction of Clarence R Studer, district sales engineer. J V MacDonald continues in charge of Los Angeles district office in new quarters at 3838 Santa Fe Ave. Also, an office has been opened in Jacksonville, Fla., under direction of David B Hill.

Dearborn Chemical Co, Chicago, announces appointment of W R Wieschendorff as district manager of its western offices. Wieschendorff makes his headquarters in Los Angeles office of the company and will also supervise operations of San Francisco and Seattle branches.

Trident Engineering Co, San Francisco, Calif., is representing the valve div of **R-S Products Corp,** Philadelphia.

General Electric Co has made several changes in its construction materials dept at Bridgeport, Conn., as follows: E N Kimball Jr has become manager of procedures div; T R Hancock, manager of marketing research div; J E Neuberger, operating manager of advertising div; and Murray H Owen has been appointed to the staff of manager of sales. In the wire and cable div, J S Overstreet and R P Allison have been named manager of sales and manager of manufacturing, respectively. C O Hull has assumed responsibility for engineering of wires and cables manufactured at Bridgeport, York, and Lowell. Also, V A Sheals has become manager of Schenectady engineering, wire and cable div.

Kieley & Mueller Inc, North Bergen, N. J., names Robert J Donnelly general sales manager; Ward K Stallings, chief engineer; and A W Bailey, general office manager.

Assistant technical director of **Allegheny Ludlum Steel Corp,** Pittsburgh, Pa., is C A Scharschu. Dr L C Hicks fills Scharschu's former position as director of research.

Foxboro Co, Foxboro, Mass., announces opening of following branch offices: At 123 W College Ave, Appleton, Wis., under management of Milton A Schreiner; in Kansas City, Mo., at 6225 Brookside Ave, where George J Willier is manager; and at 115 North 19th St, Baton Rouge, La., with John B Deaderick as manager. In

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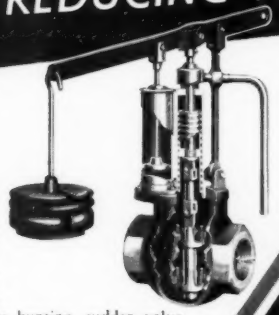
DIAPHRAGM? STUFFING BOX? NO! SPRINGS?

Klipfel NO. 1 REDUCING VALVE



A forty year service record on steam lines throughout the land proves the Klipfel No. 1 Reducing Valve to be completely dependable . . . thoroughly troubleproof. A piston and dash pot valve, the No. 1 has no springs . . . no diaphragm . . . no stuffing box . . . no trouble points. Oil filled dash pot prevents hunting, sudden valve movements and pressure fluctuations. Reduced pressure is easily adjusted by changing weight.

Suitable for any reduced pressure between 10 and 150 pounds. Sizes 1½ inch have screwed ends; larger sizes have either screwed or flanged ends.

Applications include main reduction to distributing head, auxiliary engines, vulcanizers, kettles, ironers, dryers, and pumps.

For complete details, write Dept. **BC-4** for Bulletin No. 146.

Float Valves, Reducing Valves, Tank Thermostats, Back Pressure Valves

Sold through wholesalers everywhere.

Klipfel

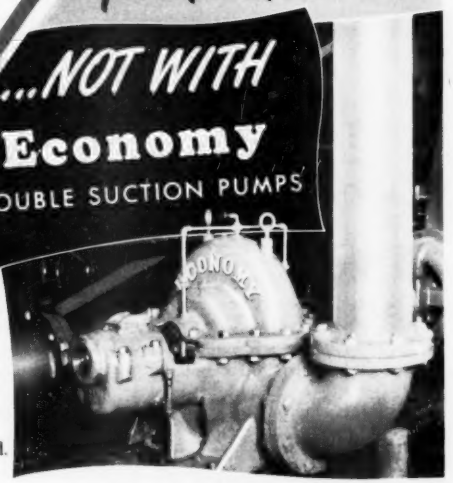
MANUFACTURING CO.

Division of Hamilton-Thomas Corp.

HAMILTON, OHIO

Caught with your pumps down?

...NOT WITH Economy DOUBLE SUCTION PUMPS



12 X10" Economy Double Suction Pump in white water service. in large felt mill. 3000 g.p.m., 40 foot head.

Pumps that are 'down' send production and profits down, too. Keep costly maintenance shutdowns to a new low with Economy Pumps . . . engineered for true economy in operation.

Economy Double Suction Pumps, illustrated, are ruggedly built for heavy mill service as well as general water supply. Advanced hydraulic design. Duplex thrust bearings mounted back to back. Effective cross lubrication to both bearings. Cartridge enclosures protect bearings . . . permitting removal of complete rotor without exposing bearings to dirt and dampness.

For the complete Economy story on Double Suction Pumps, write Dept. **BC-4** for bulletin A1147.

Centrifugal, axial, and mixed flow pumps for all applications.

Economy Pumps Inc.

Division of Hamilton-Thomas Corp.

Hamilton, Ohio

The Time to Worry About

FIRE

Is BEFORE It Strikes!

● It's frequently said that, *when fire strikes*, the first 60 seconds are the most important. But, ability to capitalize those vital seconds is equally important. And such ability comes only from *advance* planning . . . and action!

Make the check now that reveals the danger spots in your operation. Match the cost of quick, adequate protection against the loss from a disastrous fire . . . or even a small fire in a key location. The time to worry about fire is *before* it strikes!

CARDOX—pioneers of low pressure carbon dioxide as an effective fire fighting medium—will welcome the opportunity to cooperate in this vital check-up. **"CARDOX" Low Pressure Carbon Dioxide Fire Extinguishing System*** provide many fire-fighting advantages.

Such skillfully engineered systems, in pounds or tons, provide amazingly quick, positive extinguishment.

**Covered by issued and pending patents.*
Write for Bulletin 349.

CARDOX *offers all* THREE

• EXTINGUISHMENT
Cardox engineered applications give carbon dioxide enhanced effectiveness for faster, surer extinguishment of large or small fires, indoors or out

• PREVENTION
Cardox Atmosphere Inerting Systems provide low-cost inert gas for continuous fire and explosion protection

• DETECTION
Cardox Detection Systems, actuated by heat, smoke or flame, operate as a warning device or to actuate fire extinguishing systems

CARDOX

CO_2 FIRE EXTINGUISHING SYSTEMS

CARDOX CORPORATION • 307 NORTH MICHIGAN AVENUE • CHICAGO 1, ILLINOIS
DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Wheeling • Detroit • St. Louis
Los Angeles • San Diego • San Francisco

addition to these fully staffed branches, Foxboro resident engineers are now quartered in two new cities: Eugene F Machell, at 209 N 79th St, Milwaukee, Wis.; and Russell E Steward at Frankfort, N. Y., serving the Utica area.

Ralph M Johnson has been elected vice-president in charge of sales by **Norton Co,** Worcester, Mass.

Cutler-Hammer Inc, Milwaukee, names W C Lyon to succeed F H Hubbard as head of the patent dept. Hubbard continues to serve the company in an advisory capacity. Also, E F Weiss is Detroit district manager of new sales office and warehouse at 15427 Woodrow Wilson Ave, Detroit.

Thomas E Berry has become manager of domestic sales for **All-State Welding Alloys Co,** White Plains, N. Y.

Hall Laboratories Inc, Pittsburgh, Pa., promotes Charles E Kaufman to assistant director of research. Simultaneously, Dr Thomas H Daugherty becomes assistant director of chemical research for Calgon Inc, an affiliated company.

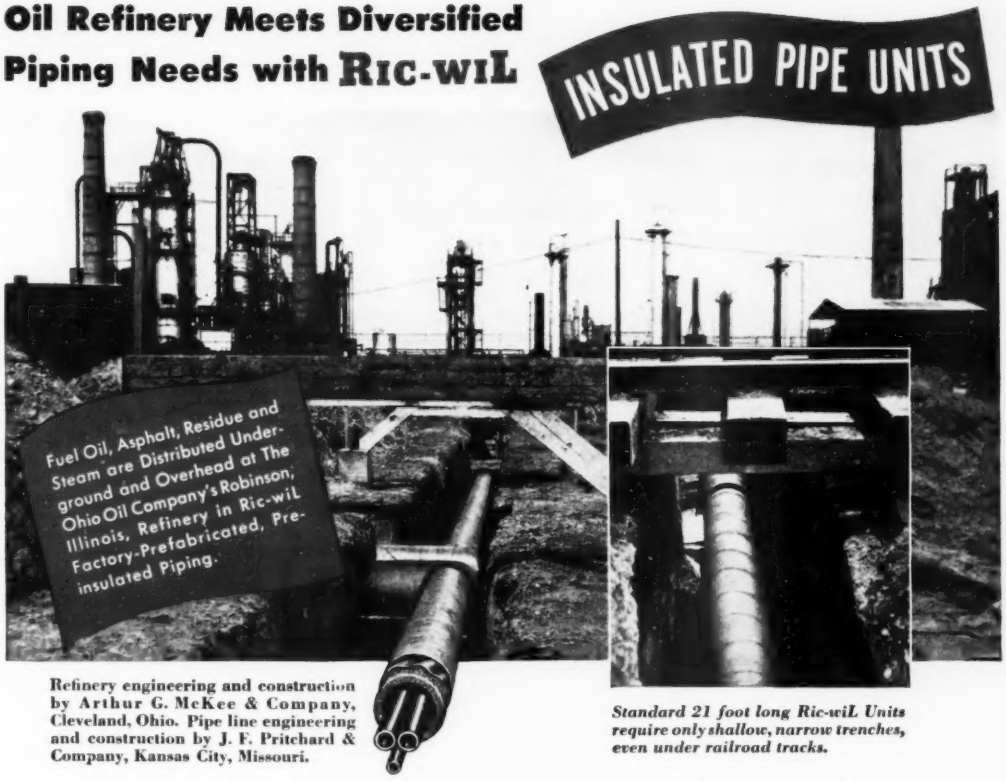
Kempton Dunn has been elected vice-president, and Cyrus E Brush secretary of **American Brake Shoe Co,** New York City. Dunn also continues to serve as treasurer of the company.

SKF Industries Inc, Philadelphia, Pa., promotes Stuart H Smith to Cincinnati district manager. Named field representatives are: C N Benson and D B Eden, Boston; A R Ehrnschwender, Cincinnati; J T Paradise, Atlanta, Ga.; and G L Hansen, Portland, Ore.

Pennsylvania Refining Co, Cleveland, Ohio, has appointed the following distributors for Penn Drake Gumout: *Chicago*—Magie Bros, 1640 W Carroll Ave; American Mexican Petroleum Corp, 155 N Clark St; Wells Petroleum Co, 816 Haines St. *New York*—Amsterdam Auto Parts Co, Amsterdam; Whipples Automotive Equip, Binghamton and Elmira; Cortland Auto Supply, Cortland; Air-Land Motor Parts, Glens Falls; Pitcher Accessories, Hudson and Poughkeepsie; Ithaca Gear & Auto Parts Co, Ithaca; Pond Electric & Battery Service, Malone; Steve's Home & Auto Supply, Monticello; J G Mezger Inc, Newburgh; Ogdensburg Battery Co, Ogdensburg; Parish Oil Co, Parish; Plattsburg Motor Service, Plattsburg; Baum's Castorine Co, Rome; Utica Gear and Auto Parts, Rome; Glen J Harvey & Co, Saranac Lake.

Additional distributors appointed by **Pennsylvania Refining** are in the following states: *Ohio*—Marsh Oil Co, Akron; Oil and Battery Service, Chillicothe; Automotive Specialties Inc, Cleveland; Auto Supply Co, Coshocton; Eldotread Tire & Supply Co, Elyria; Sanborn Motor Equip, Painesville; Asher Bros Co, Sandusky. *Other*—Clarendon Auto Service and R W Sutton Inc, Arlington, Va.; Frank W Dryden & Sons, Baltimore, Md.; Sutton Service Center, Greenville, N. C.; Johnson Bros Supply, Hickory, N. C.; Hompes Tire Co, Lincoln, Neb.; Purdon Bros, Lynn, Mass.;

Oil Refinery Meets Diversified Piping Needs with RIC-WIL


INSULATED PIPE UNITS
Fuel Oil, Asphalt, Residue and Steam are Distributed Underground and Overhead at The Ohio Oil Company's Robinson, Illinois, Refinery in Ric-wiL Factory-Prefabricated, Preinsulated Piping.

Refinery engineering and construction by Arthur G. McKee & Company, Cleveland, Ohio. Pipe line engineering and construction by J. F. Pritchard & Company, Kansas City, Missouri.

Standard 21 foot long Ric-wiL Units require only shallow, narrow trenches, even under railroad tracks.

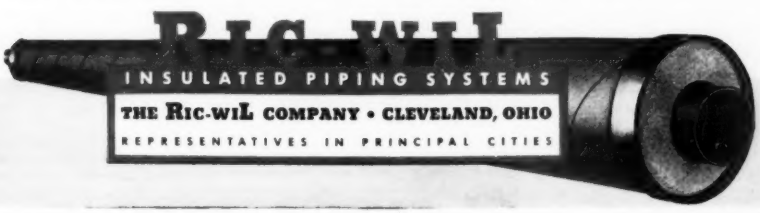
● The adaptability of Ric-wiL Insulated Piping Systems to any type of piping requirement is ably demonstrated by this refinery installation. It consists of ten separate runs of prefabricated pipe units employing a wide variety of pipe sizes and pipe arrangements for distribution of steam and viscous fluids at various temperatures.

The temperatures required for the distribution of the various viscous fluids are efficiently maintained in Ric-wiL Uniline Insulated Pipe Units. In this type of construction, pipes carrying oil, asphalt, etc., are nested with a steam tracer inside an insulation liner which insulates them from the exterior but not from each other.

At Ohio Oil, many different viscous fluids are carried in 4" and 6" pipes at temperatures ranging from 125° to 400°F. Steam for tracer lines and processing is distributed in pipes of from 1" to 6" diameter at 150 psi, 450°F.

Pipes and insulation are housed in helically corrugated, 16 gauge galvanized ingot iron Hel-coR conduit, ranging from 8" to 21" in diameter. The inherent flexibility and strength of this conduit permits underground installation with only 3'-5' cover, even under heaviest ground loads. Overhead installations require a minimum of scaffolding and supporting structures. Units may be connected on ground before being lowered into trench or erected for overhead suspension. Entire piping systems are delivered completely prefabricated with all accessories—elbows, tees, anchors, expansion loops, etc.—ready for speedy, low cost installation.

Ric-wiL manufactures three basic types of Prefabricated Insulated Piping Systems—Hel-coR, Foilclad and Cast Iron Pipe Units. Pipe, insulation, and protective covering are factory-tailored to individual specifications to meet any condition or requirement for outside piping distribution. For descriptive literature, full information, write: The Ric-wiL Company, Department 5-D.



Ice—2,000 Tons of It—Stored for Use in Summer

Another COMMUNITY REFRIGERATION CENTER Succeeds with

Frick Refrigeration

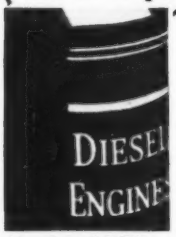
The Mutual Cold Storage Cooperative, located between Broadway and Timberville, Va., serves the prosperous Shenandoah Valley in many ways: makes 50 tons of ice daily, stores 2,000 tons, ices trucks and railway cars, operates several ice routes; quick-freezes 50,000 pounds of poultry per day; stores 375,000 bushels of apples and 1½ million pounds of frozen foods; processes fresh foods, rents 1,285 lockers; and provides cooling services to three large cooperatives—for fruit, poultry and meats—nearby.

Other Storages Hold 1½ Million Pounds of Frozen Foods

For nearly 20 years the Mutual plant has used Frick Refrigeration, now has 10 Frick machines. Any community — YOUR community — could profit from a similar Refrigeration Center. Let us give you details: write

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

How to install, operate, maintain, and repair DIESEL ENGINES



New Second Edition
556 pages, 6x9
456 illustrations, $7.00

FOR more dependable, economical, safe performance of all types of diesel engines, use the latest and best techniques outlined in this practical guide. It describes various types of engines—discusses theory and design—illustrates proper application and installation of diesels with their accessories—shows how to determine service and operating costs—and gives suggestions for choosing the right engine for your special requirements.

JUST PUBLISHED!

DIESEL ENGINES

By J. W. ANDERSON

Consulting Engineer, Diesel Engines; Formerly Mgr. of Eng., Diesel Engine Div., ALCO

This handy guide covers:
—4 automotive engines
—5 industrial power engines
—25 marine engines
—26 stationary engines
—7 railway engines

WRITTEN in simple language, this book tells you all you need to know about scavenging, supercharging and combustion—governors, control and safety equipment—cooling and lubrication systems—fuel and starting systems—and waste-heat utilization. Provides fingertip reference on installing, operating, maintaining and repairing all types.

Step-by-step procedures show you:
- how to install diesels in concrete foundations
- how to eliminate noise and vibration
- how to make routine inspections and overhauls
- how to start, run and stop diesels
- how to lay-up diesels
- how to plan inspection and maintenance schedules
- how to prevent cylinder-liner wear
- how to start engines in cold weather

10 DAYS' FREE EXAMINATION

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Send me a copy of Anderson's **DIESEL ENGINES**, 2nd Edition, for 10 days' examination on approval. In 10 days I will remit $7.00, plus few cents for delivery, or return book postpaid. We pay for delivery if you remit with this coupon. Same return privilege.

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City ..... Zone ..... State .....
Company .....
Position P-4-49

United Parts Inc, Melbourne, Fla.; John Fisher, Milton, Dela.; Peters Oil Co, Milwaukee, Wis.; Buford Bros, Nashville, Tenn.; Gulf Motor Parts, Pascagoula, Miss.; Shoobsol Co, Passaic, N. J.; Ray's Auto Supply, Petersburg, Va.; St. Joe Motor Supply Co, St. Joseph, Mo.; Pagano Bros, Vineland, N. J.; J & M Supply Co, Washington, D. C.

A Midwest direct factory sales office has been opened by **Cornell-Dubilier Electric Corp,** South Plainfield, N. J., at 605 N Washington Ave, Chicago, Ill. The office is under sueprvision of Charles H Caine. He has resigned from his partnership in the Caine Sales Co, which formerly represented Cornell-Dubilier. Also, Vernon C Macnabb has been chosen to represent the company to its manufacturing customers in Michigan. Macnabb's office address is 915 Westfield Blvd, Indianapolis.

Engineering Controls Inc, Los Angeles and New York, reports the following staff changes: Charles W Lang assumes the post of research and development engineer. Ralph A Chamberlain joins the company as sales engineer. R E Douglas is promoted to duties of assistant to the president.

An office has been established by **Vapor Heating Corp,** Chicago, in Houston, Texas. J T Elwood will work out of this office serving Texas and Louisiana.

National Supply Co, Springfield, Ohio, appoints M H Miller office manager, accounting, for its superior engine div. Miller takes over responsibilities handled by G W Wells, plant controller, until his death, Jan 16, 1949.

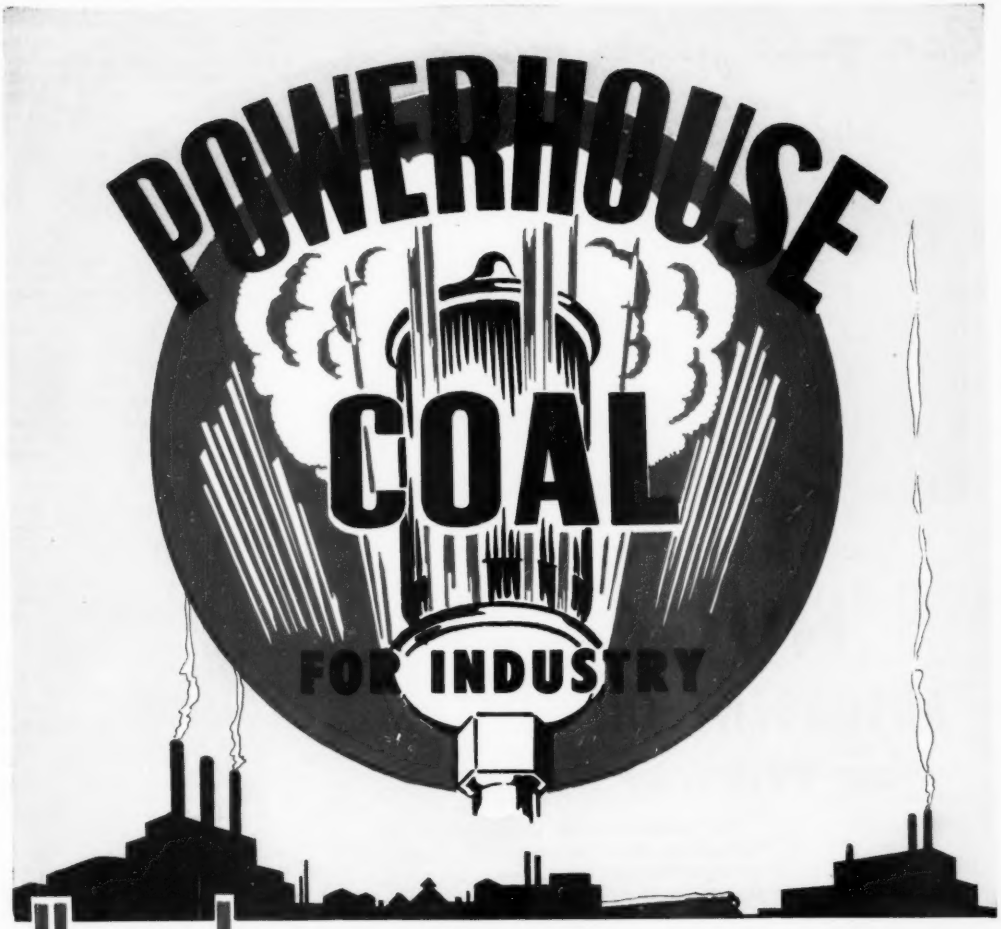
Elmer J Haines is sales representative in State of New York, exclusive of New York City, for **General Switch Corp,** Brooklyn, N. Y. Haines makes his headquarters at Kittell Road, Syracuse (Fayetteville), N. Y. Also, Frank W Garner, sales representative for the company in New England area, has had the State of Connecticut added to his territory.

Ansul Chemical Co now has a district office in Knoxville, Tenn. Joseph F Ziemann and Troverse F Schmidt are in charge.

Oliver H Schaaf has been elected president of **Air-Maze Corp,** Cleveland, succeeding A E Schaaf, who has been elevated to chairmanship of the board of directors. The new president continues to hold his position as general manager.

Ohio Brass Co, Mansfield, Ohio, announces elections of W A Springer as vice-president and treasurer of the company, and Ephraim H Brown as secretary. All other officers are re-elected. Also announced are appointments of Louis J Ott as general sales manager and R A LeFevre as advertising manager.

B F Goodrich Co, Akron, Ohio, has made the following personnel changes in its industrial products sales dept: J R Thompson has become manager of flat belting, conveyor, elevator and transmission belting,



Highly Improved Kentucky Industrial Coal

From One of the Most Highly Developed Coal Fields in the World!

POWERHOUSE Coal is produced in Muhlenberg County in the heart of the great Kentucky coal fields which today set the pace in modern mining and preparation. Because the latest equipment known to coal mining engineers is used to specially prepare POWERHOUSE Coal for industry, it delivers the utmost in efficiency at lowest cost. Big, steady production, famous for its uniformity, and tremendous reserves assure an ample supply as long as you want it.

POWERHOUSE Coal is washed, screened, sized and delivered to you ready to step up your power output in a money-saving way.

One of Southern's staff of experienced combustion engineers is ready to survey your plant and show you how this highly improved POWERHOUSE Coal can solve your boiler room problems.

Write or telephone our nearest office.

SPONSORING MEMBER COAL HEATING SERVICE NATIONAL COAL ASSOCIATION

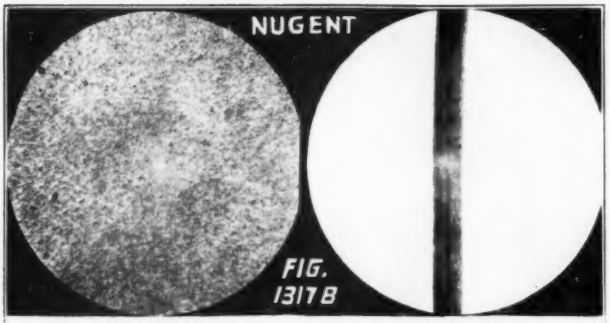
Southern Coal Company, Inc.

ATLANTA BIRMINGHAM CHARLOTTE CHICAGO KNOXVILLE
LOUISVILLE MEMPHIS NASHVILLE NEW ORLEANS ST. LOUIS
In Canada—Boon-Strachan Coal Company, Ltd., Montreal

SOUTHERN COAL COMPANY N.C.

(PH-1)

Can your filters match this cleaning power?



BEFORE AFTER
MICROSCOPIC PHOTO 100-X

NUGENT
ABSORBENT OIL FILTERS
GET 99.8% OF THE DIRT!

The "before and after" photomicrographs reproduced above are positive proof of the ability of Nugent Filters to keep dirt out of the vital working parts of your equipment. And just to give you an idea of the magnification in this view, the dark line running vertically through the "after" picture is a human hair (.0025" dia.)!

Carefully controlled tests under operating conditions show that Nugent Absorbent Filters will get 99.8% of the dirt! Translated into benefits for you this means longer life and less maintenance for your equipment and substantial savings in oil.

There is a Nugent Filter of the proper size and type to meet your requirements. Write today for complete data.

NUGENT TRADE MARK

Wm. W. Nugent & Co., Inc.
402 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

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and Paul W Van Orden manager of "V" belts and packing. Robert T Kain, who died in Dec, has been succeeded by Harold F Mosher as manager of the firm's Dallas district office. Mosher had been manager of special industrial merchandise sales and has been replaced in that post by D W Raleigh.

Miles K Smith is named vice-president and technical director of **Jessop Steel Co,** Washington, Pa.

Lloyd L Bower takes over duties of James B Fisher, who retired, as chief engineer of **Waukesha Motor Co,** Waukesha, Wis.

W D Turner, Ph D, consulting chemical engineer, has moved to 241 E 44th St, New York City.

Kuljian Corp, Philadelphia engineers and constructors, announces appointment of Edwin Lundgren as their Washington, D. C., representative. Offices are located at 1415 K St, N W.

Lyle B Porter has resigned as director of research for **Illinois Water Treatment Co,** Rockford, Ill., to establish a consulting engineering service. Porter will specialize in water treatment, ion exchange and industrial waste disposal, with headquarters at 1707—15th Ave, Rockford, Ill.

Kinsley McWhorter and Associates, consulting engineers, and James Berkeley Robinson, architect, have formed the firm of **McWhorter, Robinson and Moody** for the general practice of engineering and architecture. Their offices are in the Witz Bldg, Staunton, Va.

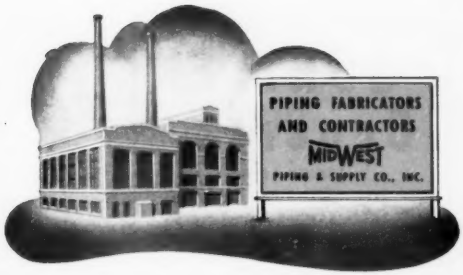
O S Tyson & Co, New York City, advertising agency, has reported the following elections in its company: Fay Keyler—*president;* Kenneth W Bailey—*vice-president;* Irwin W Tyson—*vice-president* and *treasurer;* Richard V Morrison—*vice-president;* Mildred G Gleason—*secretary* and *assistant treasurer.*

Jack Gillespie is now chief engineer of **Crete Municipal Power Plant** in Crete, Neb.

John T Ward becomes vice-president in charge of engineering and operation for **Boston Edison Co.** He assumes the duties but without title of chief engineer, while Robert E Dillon is designated vice-president and assistant to the president.

Eugene W O'Brien, former national president of American Society of Mechanical Engineers, has been elected president of newly organized **Engineers and Architects Council of Georgia.** Other officials include dean Cherry L Emerson, Georgia Institute of Technology, and George M Normandy, Georgia Power Co., secretary-treasurer.

Arthur D Little Inc, Cambridge, Mass., announces that Professor Thomas K Sherwood, dean of engineering, Massachusetts Institute of Technology, and Dr Bruce S Old have been elected to the board of directors of the firm. R C Griffin has retired as director and as assistant secretary



FIRST-HAND EXPERIENCE IN THE FIELD

Helps Maintain the HIGH QUALITY of

MIDWEST

PRE-FABRICATED PIPING

Midwest not only has a pipe fabricating organization of exceptional skill . . . it also has a Construction Department which has been erecting all kinds of piping for 48 years.

As a result, our shops get continuous first-hand field reports on the erection of fabricated piping. Our Construction Department constantly keeps us mindful of the importance of accurate alignment, thorough cleaning, careful inspection and testing of all bends, welded subassemblies, etc., before they leave the shops.

This situation has been of immense value in maintaining the high quality of Midwest Piping. The Construction Department also is the source of countless suggestions for improvement in pressure piping. All Midwest customers benefit from the accumulation of these suggestions.

Midwest, with four fabricating plants strategically located, has nationwide experience in satisfying the piping needs of all industries. You will always find it advantageous to use Midwest Pre-Fabricated Piping . . . either when purchased on the basis of materials only or piping completely installed.

MIDWEST PIPING & SUPPLY CO., INC.
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PIPING FABRICATORS AND CONTRACTORS

3480

"GUNITE" Concrete

(SINCE 1915)

Linings for

STEEL BUNKERS •
DUCTS, HOPPERS •
STACKS •
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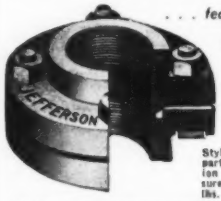
"See our catalog in Sweet's"

Jefferson

FLANGE UNIONS

. . . *featuring the*

RECESSED BRASS SEAT



Style "D", 2-part Flange Union for test pressures up to 4000 lbs.

Make up permanently tight without undue wrench pressure

Jefferson Flange Unions . . . like all Jefferson Unions . . . are made of air-refined malleable iron and designed around the exclusive RECESSED BRASS SEAT. This construction provides a metal-to-metal spherically ground seat which is permanently tight without applying unnecessary pressure in making up. Location of the seat is such that threaded pipe ends cannot come in contact with it. Flow through the fitting is free and unrestricted. Every union is air-tested.

Jefferson Flange Unions are available in two and three-part types in a wide range of sizes. Full details available through your nearest distributor or from us direct.

JEFFERSON UNION CO.

605 W. 26th St. New York 1, N. Y.

63 Gooding St. Lockport, N. Y.

18 Fletcher Ave. Lexington 73, Mass.

under the organization's retirement plan. The company officers for 1949 are: Earl P Stevenson—*president;* Raymond Stevens, Thorne L Wheeler and Leroy F Marek—*vice-presidents;* Henry G Powning—*treasurer;* Frank N Houghton—*secretary* and *assistant treasurer;* Helge Holst—*assistant secretary;* and Howard J Billings—*assistant treasurer* and *assistant secretary.*

Philadelphia Electric Co names William F Roth and Maitland Roach superintendent of Delaware div and Eastern div, respectively. Also, Clinton L Gattey and David S Mayson are now electric superintendent of Delaware div and Eastern div, respectively. John I MacPherson becomes assistant superintendent, overhead lines section of Philadelphia div. And, Horace MacVaugh Jr is appointed to position of general superintendent of the utility's suburban divisions. W H Jones becomes purchasing agent.

Midwest Stoker Ass'n, Chicago, announces the following election of officers: *President*—E W Jones, office manager for Chicago factory branch of Iron Fireman Mfg Co; *vice-president*—F H Herndon, president, Herndon Sales & Service Co; *secretary-treasurer*—P I Bohmann, district manager, U S Machine Corp. Above officers are also elected to board of directors together with F J Moran, sales manager, C E Sundberg Co, and Charles Requa, Central Fuel Corp.

Edward Kellie, president, Aminco Refrigeration Products Co, Detroit, Mich., is new chairman of flow control valve section of **Refrigeration Equip Manufacturers Ass'n.**

National Ass'n of Engineering Companies names Stewart Kerr, a Detroit attorney, executive secretary of the organization.

Dr Enrico Volterra of Rome, Italy, has been appointed associate professor of mechanics at **Illinois Institute of Technology,** Chicago.

OBITUARIES

Dr William Monroe White, 77, retired manager and chief engineer of Allis-Chalmers hydraulic dept, died Feb 9 in Jackson Memorial Hospital, Miami, Fla.

George W Wells, 66, comptroller of Superior Engine div, National Supply Co, Springfield, Ohio, died Jan 16 in that city.

Harry Woodward Beedle, 69, retired manager of Boston branch, Electric Storage Battery Co, died Feb 3.

Thomas O Moloney, 76, founder and board chairman of Moloney Electric Co, died Jan 30 of heart disease at his home in University City, Mo.

Matthias J Flaherty, head of Flaherty & Co, Boston heating and ventilating engineers, died Jan 26 in Chicago

Gustaf L Kollberg, 70, retired Allis-Chalmers executive who was identified with engineering, designing and installation of many large triple expansion and compound

From Small Schools to Huge Plants . . .

WATER HAMMER is serious

but is so easily eliminated with

THE WILLIAMS-HAGER *flanged* SILENT CHECK **VALVE**

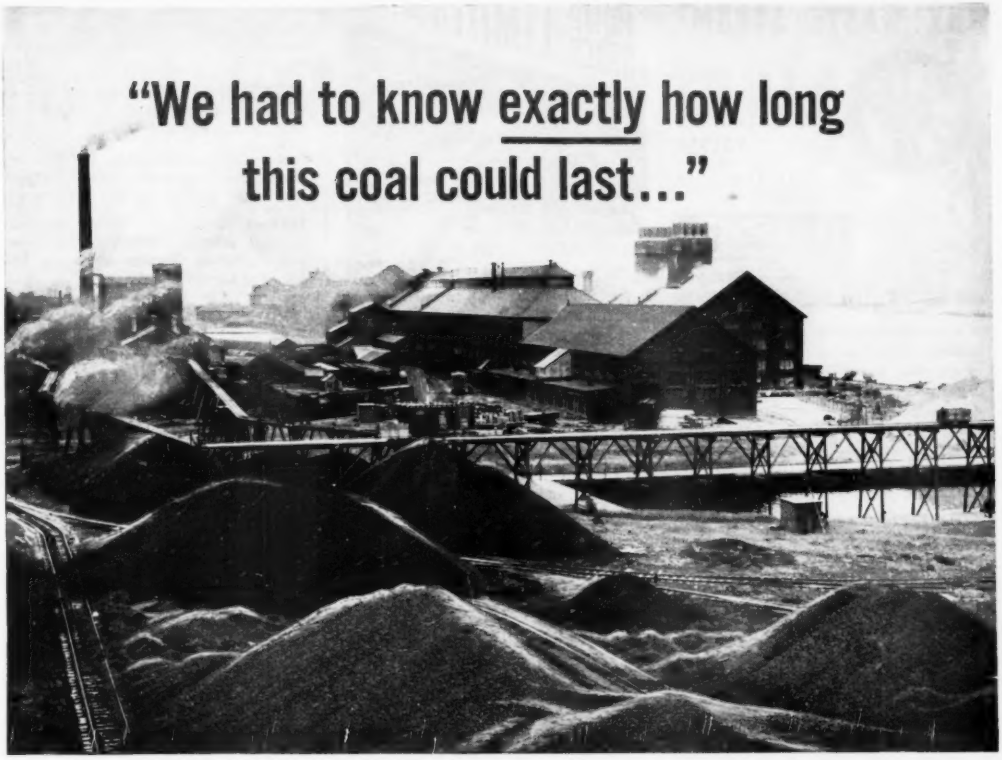
Write for complete information on The Williams-Hager Flanged Silent Check Valve—that has proven successful on the most difficult installations.

THE WILLIAMS GAUGE CO.

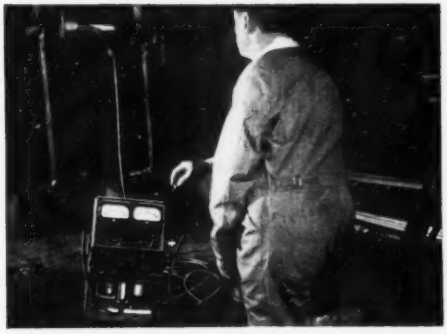
Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Steam Traps . . . Pump Governors . . . Feed Water Regulators . . . Water Columns

2055 PENNSYLVANIA AVE. • PITTSBURGH (12), PA.

"We had to know exactly how long this coal could last..."



"THE REMARKABLE CITIES SERVICE INDUSTRIAL HEAT PROVER TOLD US"



THE INDUSTRIAL HEAT PROVER is an exhaust gas analyzer, designed for use on industrial furnaces regardless of size or type. It is provided with two scales; one shows the percent of oxygen present above the theoretical amount necessary for complete combustion, the other the amount of unburned fuel going into the atmosphere.

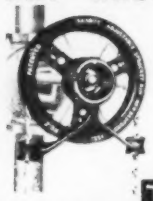
"GUESS WORK on coal consumption was a critical problem with us. We had to know, ton-for-ton, exactly how much power we could generate efficiently. When the Cities Service representative demonstrated the Heat Prover, the results were astonishing. This remarkable instrument told us quickly, accurately and continuously how much fuel we needed for maximum efficiency... how much was wasted by needlessly heating excess air... and how we could correct this loss."

If you feel your operation could profit from scientific control of combustion why not get in touch with a Cities Service representative today. Ask for a free demonstration of the Cities Service Industrial Heat Prover.

Free — A new fact-filled booklet entitled "Combustion Control for Industry." Write Cities Service Oil Company, Room 370, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

WHY WASTE STEAM?



Equip HARD-TO-REACH VALVES with Low-Cost

Babbitt Adjustable SPROCKET RIM with Chain Guide

● Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

● Much steam is wasted in industrial plants because overhead, out-of-reach, inaccessible valves either remain untouched and open, or are subject to hit-or-miss control. Turn this waste into dollars saved. Put those valves to work by getting the low-cost BABBITT Adjustable Sprocket Rim with Chain Guide. Valve control thus becomes easy, quick, regular—right from the floor!

● The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

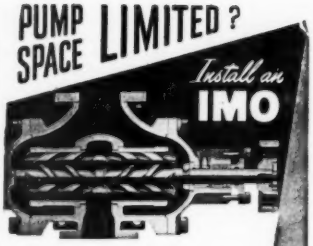
● *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.*

BABBITT STEAM SPECIALTY CO.

1 Babbitt Square, New Bedford, Mass.

PUMP SPACE LIMITED?

Install an IMO



● The capacity of the IMO is increased by high speed operation. This compact pump can be directly connected to the driving machine without bulky speed reduction gearing.

● IMO Pumps can be furnished for practically any capacity and pressure required for oil, hydraulic-control fluids and other liquids.

Send for Bulletin I-146P

IMO PUMP DIVISION of the DE LAVAL STEAM TURBINE CO.

ALLPAX the PACKING that never sticks...

ALLPAX is the packing that does the packing job *right*. You can use it advantageously on hot or cold liquids or gases and be assured of a leak-tight, scoring-free service which will save you time and money in maintenance. Because of its field of application, ALLPAX is a *universal* packing.

ALLPAX never sticks because it is compounded in such a way as to prevent it. Thin flakes of anti-friction metal and tiny scales of graphite are imbedded all through long, tough fibres of asbestos. To this is added a special non-liquid, heat-proof lubricant. Shafts and rods rotate or slide smoothly without scoring or sticking.

ALLPAX is available in various diameters for a wide range of stuffing box sizes and is easily cut to exact length required and slipped into place without waste. Available also in loose form for general service.

A trial of ALLPAX will quickly convince you that ALLPAX is the packing for your packing jobs. Your nearest distributor can supply you.

THE ALLPAX COMPANY, INC.
Mamaroneck, N. Y.

reciprocating pumping engines built for municipal water works service in this country, died Feb 2 at his home in Milwaukee.

Jacob Hekma, 69, vice-president of Commonwealth & Southern Corp, died Feb 17 in Palm Beach, Fla.

Sydney Charles Hughes, 75, stationary engineer at Montgomery Bros & Co, Buffalo, N. Y., died Jan 20 of a heart attack.

Michael Reddy, 72, retired stationary engineer formerly connected with Metropolitan District Commission, Boston, died Jan 24 at Quincy, Mass.

Albert L Pearson, 69, electrical engineer of construction div, Metropolitan District Commission, Boston, died suddenly Jan 21 in his office.

John G Roberts, 68, stationary engineer employed by Utica Steam Engine and Boiler Works, and Proctor High School, died Jan 23 in Utica, N. Y., after a long illness.

D A Powell, 65, executive vice-president of Iowa Power & Light Co, Des Moines, Iowa, died recently at Iowa Methodist hospital following an emergency operation.

Ray Ingham, 58, vice-president and general manager of Central States Electric Co, and Iowa Electric Co, died recently at his home in Cedar Rapids, Iowa.

Plant Problems

(*Continued from page* 176)

passes top of baffle it is suddenly flashed to steam, causing a slight difference of pressure in the tubes. That, plus the weight of water head in the middle drum, results in sluggish circulation and consequently sludge slowly forms in bottom section of tubes.

SW should extend baffle behind first bank of tubes upward and bend its top at an angle of 45 deg instead of 90. Gas flow would then strike first row of tubes, increasing heat equally at bottom of tubes and improving water circulation.

JAMES A WEEKS *Nova Scotia*

Adjust the Second Baffle

ANALYSIS OF TUBE DEPOSIT shows a concentration as found in average tube deposits. In fact, *SW* probably has the same deposit on drum sheets.

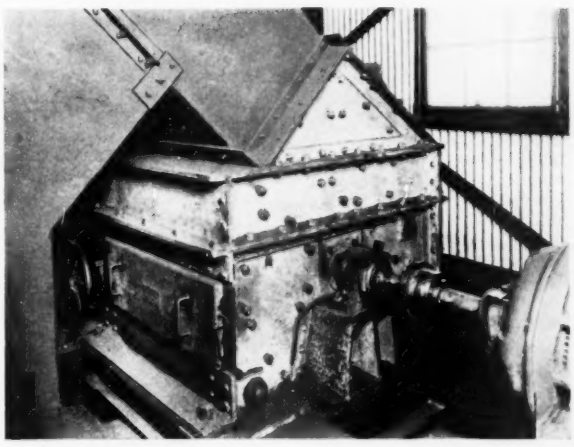
This problem centers around poor circulation in the front tubes on the second bank and may be caused by these tubes steaming and holding water back at throat of middle drum. I have seen this occur on this type boiler. Solution is to open up baffle on the second pass. I would say six inches will clear up this condition. Pulled tubes are an indication of excess heat and poor circulation. I do not believe that *SW*'s present condition is derived from blowdown neglect.

R SID CADWELL *Chicago, Ill.*

Why the PENNSYLVANIA GRANULATOR GIVES YOU *LESS* OVERGRINDING *and MORE* GRANULATION

Even though the "crushability" of some coal is very high, the Pennsylvania Granulator (because of its design and slow speed) produces less extreme fines than conventional types. This is due to the exclusive Pennsylvania reduction principle that causes the rings to reduce the oncoming feed by a rolling compression, greatly diminishing the attrition or "scouring action", thus giving a more granular, free flowing product.

We have a bulletin that describes this principle in detail. Just drop us a line and we'll send it along. Incidentally, Pennsylvania Granulators are equipped with a non-magnetic, non-power-using Separator that automatically traps tramp iron and other metallics.



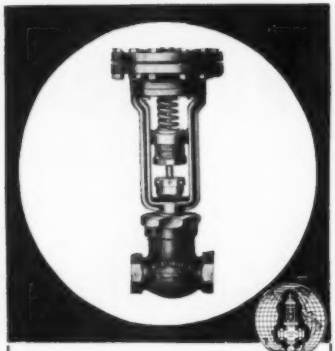
PENNSYLVANIA CRUSHER COMPANY

DIVISION OF BATH IRON WORKS CORPORATION

Liberty Trust Bldg., Philadelphia 7, Pa.

New York • Pittsburgh • Chicago • Los Angeles • Birmingham—Associated with Fraser & Chalmers Engineering Works, London

Manufacturers of a complete line of crushing equipment • Hammermills • Single Rolls • Bradmills • Jaws • Gyratories • Granulators • Impactors • Bradford Breakers



ATLAS
Type "D"
Reducing Valve

The valve shown above—Type "D"—is Fig. 171 in our 52-page Bulletin 1-A.

Type "D" has made very much of a "hit" with engineers. It is unusually simple. Always gives accurate and close regulation of pressures. Is easy to inspect. Equipped with single seat renewable discs of composition or metal. Stainless steel valve stem. Removable diaphragm top. Adaptable to steam, air, or gas. Up to 175 lb. per sq. in. pressure. Durable. Body of bronze. Screwed ends. And, its construction gives it true balance with double port seats.

You can be sure of best regulating valve service by always putting your regulating problems in the hands of ATLAS engineers. For more than a half century we have been specializing solely in regulating valves. See the list of principal ATLAS Products below. Make use of the coupon.

ATLAS VALVE COMPANY
ALL REGULATING VALVES FOR EVERY SERVICE

289 SOUTH ST., NEWARK 5, N. J.

Represented in Principal Cities

☐ Without obligation, please send me the ATLAS Regulating Valve Bulletin No. 1-A. Also, please send complete information on the following ATLAS products:

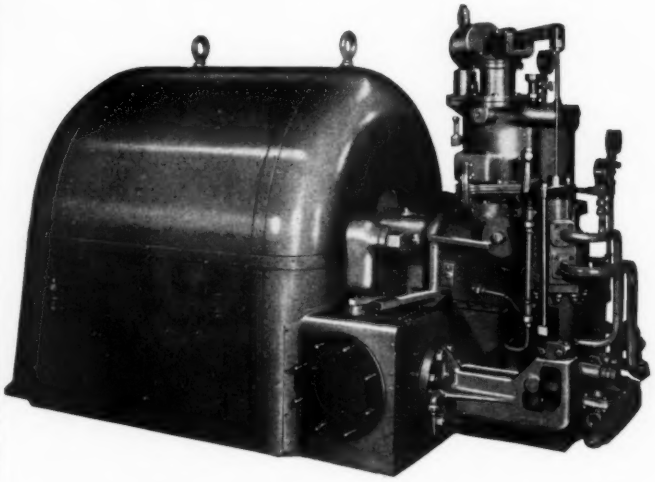
☐ Damper Regulators	☐ Pump Governors
☐ Temperature Regulators	☐ Oil Control Cocks
☐ Exhaust Control Systems	☐ Humidity Controllers
☐ Pressure Regulators	☐ Thermostats
☐ Campbell Boiler Feed Water Regulator	☐ Balanced Valves
	☐ Control Valves

Name _____

Firm _____

Address _____

MURRAY
TYPE UV



MULTI-STAGE STEAM TURBINES

Simplicity and reliability characterize the Murray Type UV Turbine. Available in from two to ten pressure stages on two basic pitch diameters. The Type UV can be supplied in capacities from 100 to 4000 HP, condensing or non-condensing. It can be used for mechanical drives or for smaller generator drives.

Murray Type UV is durably built for dependable performance. Horizontally split case construction to suit operating conditions. Blades are stainless steel, shafts of alloy steel. The assembled rotors are dynamically balanced. Governors are provided to suit specific job requirements.

Let our engineers cooperate in smoothing out your power problems.

WRITE FOR BULLETIN T-122

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

Let COCHRANE Guard Your Water Supply

COCHRANE CORPORATION 86 YEARS OF SERVICE 1863 - 1949

THE HEART
of every Zeolite Softener
is its control equipment
ONLY COCHRANE
has the
HYDROMATIC*
SINGLE CONTROL
VALVE

*Another Cochrane engineering achievement—patents applied for

YOU get the Hydromatic Single Control Valve as standard equipment on Cochrane Zeolite Water Softeners. . . . This exclusive patented feature, developed by Cochrane engineers, combines, in a single unit, a 4-position valve for service, back wash, brine and rinse, and in addition has 2 stand-by positions.

Write for bulletins — coupon is for your convenience.

Illustrated above is a single-unit manually operated Cochrane HYDROMATIC Zeolite Softener. It is also designed for automatic operation. A small 30-watt motor turns the valve positioner.

COCHRANE CORPORATION • PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS • FILTERS • DEAERATORS • SPECIALTIES

COCHRANE CORPORATION
3106 N. 17th St., Philadelphia 32, Pa.

Please send bulletin describing Cochrane Hydromatic Zeolite Softener.

Name.....

Title.....

Company.....

Address.....

City..... *State*.....

CATAWISSA

BALL-TO-ANGLE SEAT gives you a PERFECT SEAL...

...even when the pipe is not perfectly aligned!

HOT FORGED from solid, rectangular steel bars, Catawissa Pipe Unions are free from sand and blow holes. The ball-to-angle seat design plus their ability to expand and contract with the pipe give you sure fire dependability . . . a perfect seal for every application!

HOT FORGED STEEL
STAINLESS STEEL
Full ACME Threads or U. S. V-Threads in Union nuts and on female end.
STANDARD AND DOUBLE EXTRA HEAVY

WRITE FOR COMPLETE ENGINEERING DATA AND YOUR COPY OF BULLETIN 10-A

CATAWISSA VALVE & FITTINGS CO.
206 Mill St. • CATAWISSA, PENNSYLVANIA

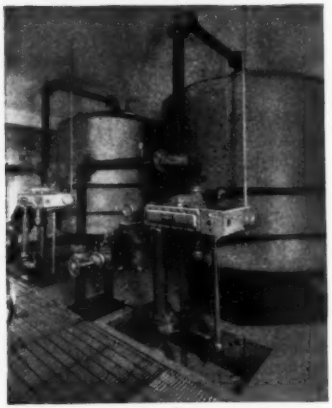
HERE'S A *Parade* YOU WON'T WANT TO MISS...

F-158

Everybody loves a parade but here's one that's particularly interesting to YOU because it's packed with "pocket-book" appeal. It's a never-ending parade of products and services designed to help you do *your* job better, quicker and cheaper. You're in the "reviewing stand" for this parade because it comes to you in the advertising pages of every issue of this magazine. Alert manufacturers use these advertising pages to get the *news* about their products and services to *you* . . . quickly and effectively. To be well-informed about the latest developments in *your* industry . . . and to stay well-informed . . . *read all the ads too.*

McGRAW-HILL PUBLICATIONS

BELCO FULLY AUTOMATIC WATER SOFTENER INSTALLED IN MIDWESTERN MUNICIPALITY



The most recent advancement in automatic water softener control is illustrated above in the Belco motor operated single control valve. This plant produces 1.25 mgd of soft water with exceptionally low operating cost and minimum maintenance.

The unique features of the Belco Multiport Valve are that rubbing rotors are completely eliminated, pressure losses are reduced to a minimum and the high mechanical advantage makes it feasible to use a low H. P. electric motor for valve functions.

The saving in pumping and electrical costs for operating the multiport valve as well as the low chemical cost utilizing Belcolite Resins have resulted in a far more economical plant.

MODERNIZATION RESULTS IN LARGE OPERATING SAVINGS

The Belco automatic valve and Belcolite Resins can be applied to existing water softening installations to lower maintenance and chemical costs to such a degree that in most cases they will repay the original expense in a few months.

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.
56 Iowa Avenue Paterson 3, N. J.
Midwest: Deady Chemical Co., Kansas City, Mo.
South: Gulf Engineering Co., Inc., New Orleans, La.
Florida Industrial Equip. Distr., Miami, Fla.
Southwest: Watermasters Inc., Houston, Texas
Pacific: Deady Chemical Company, Los Angeles, Cal.

Belco

PROCESSES FOR REMOVAL OF WATER IMPURITIES

Changes hustle to muscle— with TIMKEN® bearings

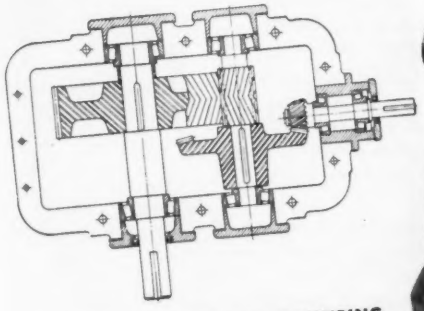
WITH Timken® bearings carrying the pinion shaft and high and low speed gear shafts, speed reducers made by the D. O. James Gear Manufacturing Company are assured of long, trouble-free service.

Under even the toughest loads, Timken bearings hold shafts in rigid alignment. Gears mesh with constant precision and wear is minimized. Due to the tapered construction of Timken bearings, any combination of radial and thrust loads is carried without deflection or end-play. They're manufactured to incredible precision, finished to amazing smoothness. Timken bearings permit tight closures to effectively retain lubricants and keep out damaging dust and dirt.

Full line contact between the rolls and races provides maximum load carrying capacity. And since they're made of the finest alloy steel ever developed for tapered roller bearings—Timken fine alloy steel—Timken bearings normally last the life of the machine.

No other bearing can offer *all* the advantages you get with Timken bearings—backed by almost fifty years of bearing research and development. That's why it's advisable to make sure that Timken bearings are included in every machine you buy or build. Look for the trade-mark "Timken" on the bearings: The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



D. O. JAMES GEAR MANUFACTURING COMPANY *uses Timken bearings on pinion shaft and high and low gear speed shafts in their right angle spiral bevel herringbone gear speed reducer.*

NEW TIMKEN BEARING CUTS RUN-OUT IN HALF!

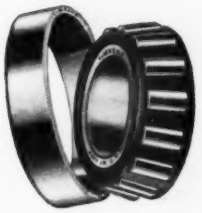
Until now, the Timken "Zero" bearing has been the last word in bearing accuracy. Now Timken offers industry the "Double-Zero" bearing—*twice as accurate* as the "Zero"! Maximum run-out of the new "Double-Zero" bearing is only 75 millionths of an inch—*half* the 150 millionths run-out of the "Zero" bearing.

What an opportunity for manufacturers of machines where extreme accuracy is essential! Available in standard single row types, up to 10" O.D. Write for further information.

TIMKEN

TAPERED

ROLLER BEARINGS



NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

R/M BRAIDED ASBESTOS PACKINGS

The power engineer will find in the R/M packing line a complete assortment of high quality packings and gasket materials for practically every type of modern industrial equipment.

R/M Square-Braided, Centrifugal Pump Packing No. 365 is relied on in many plants for use in Corliss valves, centrifugal and rotary pumps, and expansion joints handling hot or cold water and steam. It is of high quality asbestos yarns, with a plaited braid construction. It is available either lubricated, dry, or wire inserted (No. 366).

R/M Braided Asbestos Packing Squared No. 360 provides an efficient sealing material for valve stems, expansion joints, and other services where a soft, asbestos packing is needed. It is manufactured of long-fibre asbestos yarn in braid over braid construction, and is then squared. Also available wire inserted (No. 361).

For asbestos, metallic, jute, sheet, rubber, plastic, or other packings, check your R/M Packing Catalog, and consult with the authorized R/M packing distributor near you. R/M distributors are established suppliers of recognized ability and reputation, specializing in industrial packings.

R/M No. 365

RM

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

Factories:
Bridgeport, Conn.; Manheim, Pa.
No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts Radiator Hose • Powdered Metal Products • Bowling Balls

STOP BOILER FOAMING and CARRYOVER WITH

DREW *Antifoam D*

Carryover of moisture and solids with steam may be caused by improper chemical conditions in boiler water. In addition to heat losses, carryover causes steam line, superheater and turbine deposits.

DREW ANTIFOAM D controls foaming and carryover at all pressures, including the high pressures encountered in modern boiler design. When combined with Drew Organics, sludge adherence and feedline deposits are also eliminated. It is economical and simple to use.

Your local Drew engineer is available to discuss all aspects of water treatment and related problems.

POWER DREW CHEMICALS

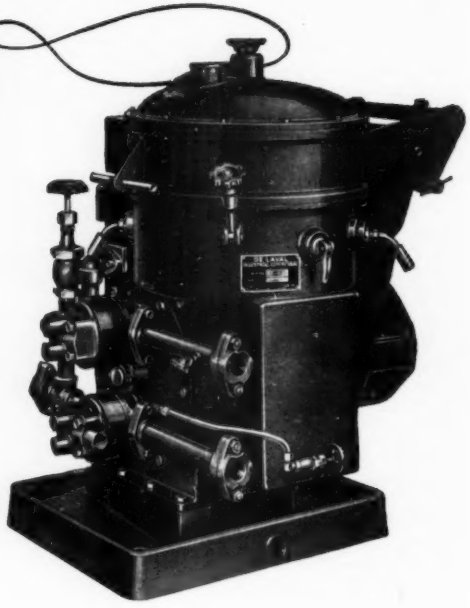
E. F. DREW & CO. INC.
15 E. 26th ST., NEW YORK 10, N. Y.
Representatives in all key cities

BOILER WATER TREATMENT
COOLING WATER CONDITIONING

NEW

THE NO. 67 "UNI-MATIC" OIL PURIFIER

for plants purifying 450-550 G.P.H. of lube or fuel oil



The De Laval No. 67 "Uni-Matic" Oil Purifier has a capacity of approximately 450 gph (Navy rating) when purifying turbine lubricating oil. When used to remove contaminants from Diesel lube or fuel oil, its capacity varies from 200 to 550 or more gph, depending on the grade of oil.

Now publicly announced for the first time, the "Uni-Matic" No. 67 has already proved itself on many installations in stationary power plants and in the engine rooms of ships at sea. A single, compact oil purifying unit, complete with pumps and heater, it provides exactly the same advantages common to the other three sizes of "Uni-Matic" Oil Purifiers. That is, it removes ***both*** of the chief contaminants of oil, ***water*** and ***dirt***. It provides complete protection to the turbine or Diesel engines whose bearings it safeguards or, when used on Diesel fuel oil, it makes it possible to obtain the maximum BTU value of the oil.

- Ask for additional details on the No. 67 "Uni-Matic."

De Laval

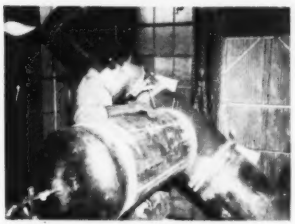
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

LUBRICATING OIL PURIFIERS

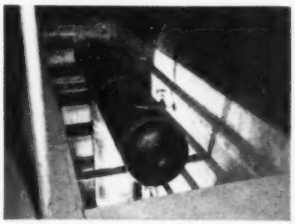
TUBE-TURN

WELDING FITTINGS AND FLANGES

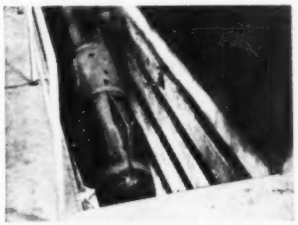
18-inch standard weight Tube-Turn welding tee and pipe laid out preparatory to assembly for hydrostatic pressure test.



Welder completing last bead in assembly. Fitting and pipe now form homogeneous, leakproof unit.



Assembly is hung in pit, massively lined with concrete. During test top grating is closed and held down by a barricade of sandbags.



Final result after hydrostatic pressure test. The straight pipe burst first, and the tee is undamaged.

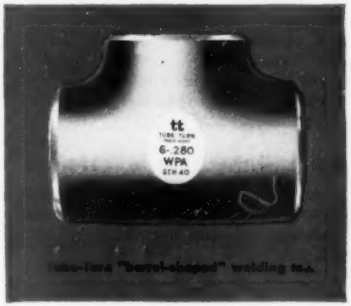
Strength through Design in Tube-Turn welding fittings

The pipe burst first!

Take an 18-inch standard weight welding tee. Take three corresponding lengths of pipe. Weld tee and pipe together. Cap the ends. Lower the assembly into a pit. Then apply hydrostatic pressure—much more than the assembly is supposed to take!

Something has to give! According to the accepted beliefs it should be the tee. But not in the case of the test pictured here. The Tube-Turn "barrel-shaped" tee was used—and the pipe burst, well before the tee was affected! Throughout numerous tests, this new type of tee has withstood at least 25 per cent more pressure than required by the formula given in ASA B16.9.

The superior strength of the tee was achieved without running up extra weight and cost, by carefully planned improvements in shape (based on the sphere, nature's strongest form for internal pressure), and by a carefully engineered distribution of metal.



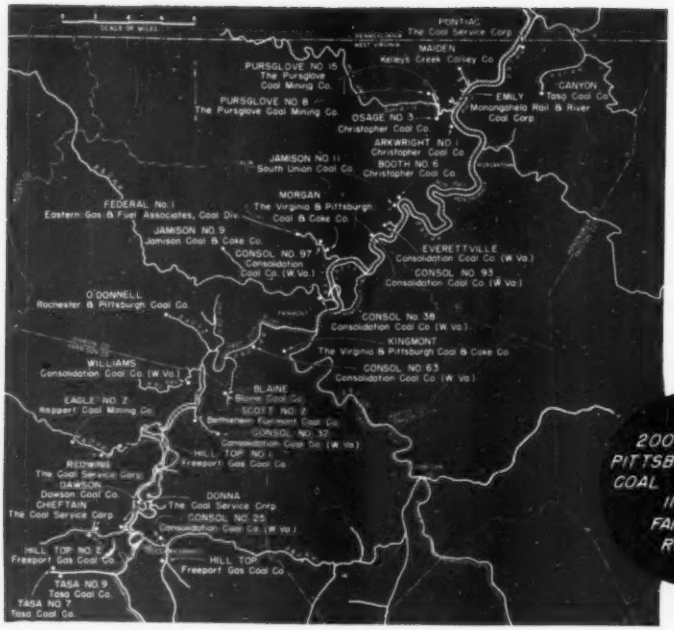
Tube-Turn "barrel-shaped" welding tee.

This is a typical example of *strength through design* in Tube-Turn welding fittings, and another good reason why leading piping engineers specify Tube-Turn equipped, welded piping.

TUBE TURNS, INC.

236 East Broadway, Dept. G, Louisville 1, Kentucky

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles



200 YEARS' PITTSBURGH SEAM COAL RESERVES IN THE FAIRMONT REGION

CONSERVATIVE DESIGN *assures maximum fuel dollar savings*

Conservative design constitutes liberalizing furnace dimensions, water cooled wall surfaces and correct slag screen arrangement to lower furnace exit temperature below the ash softening temperature of the coal available to the plant at lowest Btu cost. Ample pulverizer capacity or stoker grate area combined with a cool furnace make a steam generating unit of broad fuel utilization capabilities.

Quick Return on Investment

Engineering steam generating equipment for complete fuel flexibility slightly increases capital investment . . . not over 10%. A year's operation will pay out the added cost.

An Equipment Dime Can Save a Fuel Dollar

Sizeable fuel savings are yours for the life of your plant if your equipment is burning Fairmont Pittsburgh Seam Coal. Fairmont Coal Bureau Engineers are glad to assist you in attaining maximum fuel dollar savings.

TYPICAL FUEL SPECIFICATIONS FOR DESIGN

Avg. (%) for Performance Guarantees	*Size 5/8" or 3/8" x 0*	*Extreme (%) for Full Capacity*
5.0	Moisture	10.0
35.0	Volatile	38.0
51.2	Fixed Carbon	40.0
8.8	Ash	12.0
2.5	Sulfur	3.5
13,290	Btu	12,200
2150	*A.S.T.	2,000
60	Grindability (Hardgrove)	50

*Ash Softening Temperature

MAIL COUPON TODAY

FAIRMONT COAL BUREAU, Chanin Bldg., 122 E. 42nd St., New York 17, N. Y.

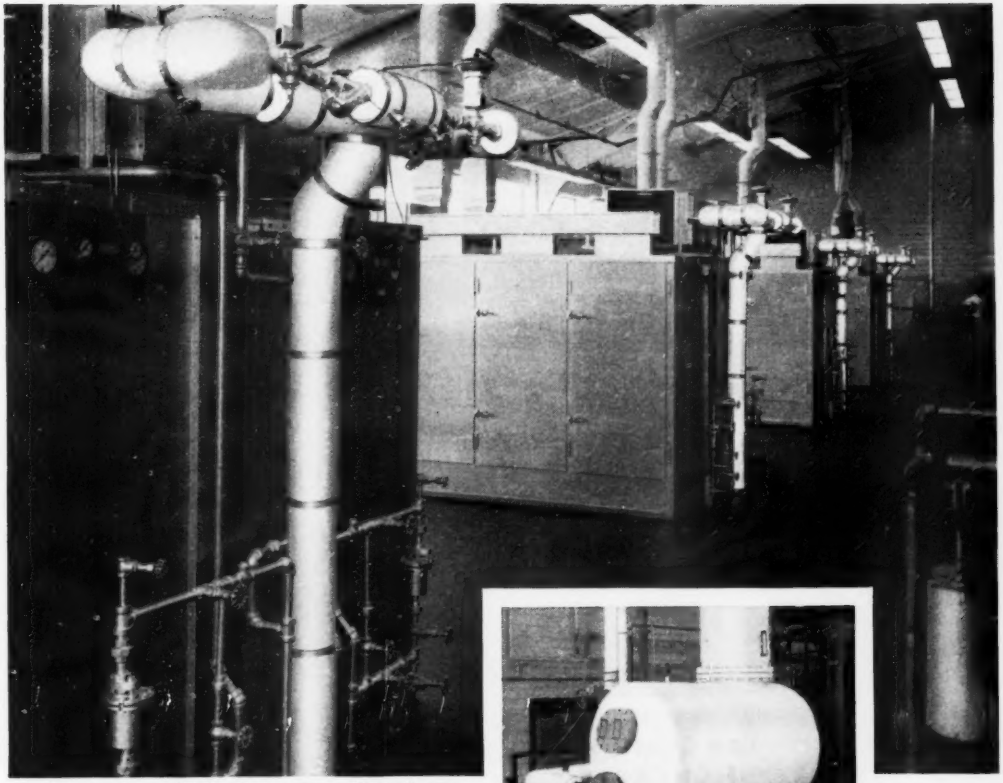
Kindly place me on your mailing list to receive copies of your publications and Technical Reference Bulletins.

Name ..... Company .....

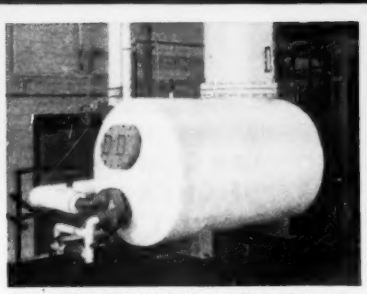
Position ..... Nature of Business .....

Address ..... City ..... Zone ..... State .....

FAIRMONT COAL BUREAU · FAIRMONT REGION · WEST VIRGINIA · SERVICE TO INDUSTRY ·



Drying closets in plant of The Bayer Company Division of Sterling Drug, Inc., Trenton, N. J. The 60-lb. steam pipes are covered with K&M "Featherweight" 85% Magnesia Insulation, 2 inches thick, canvas pasted and banded.



Reclaim Solvent Still in the Trenton plant. Tank and tower are insulated with 2-inch 85% Magnesia Block, finished with asbestos cement; steam line with 2-inch thick 85% Magnesia; return line with Standard Thick 85% Magnesia.

Where temperature control is important—

K&M "Featherweight" 85% Magnesia Pipe Insulation

Nature made Asbestos...
Keasbey & Mattison has made it serve mankind since 1873

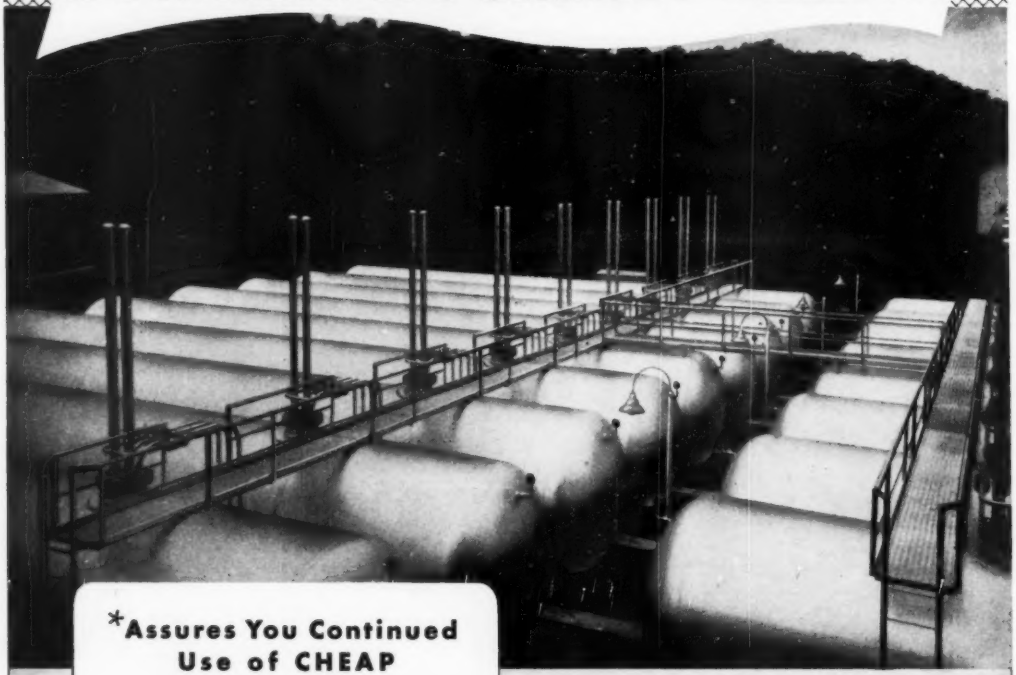
In the Trenton, N. J. plant of The Bayer Company Division of Sterling Drug, Inc. temperature control is vastly important. Insulation of *known* dependability is essential.

K&M "Featherweight" 85% Magnesia Pipe Insulation was used because in a wide variety of applications it has proved efficient and durable. It combines the high insulating properties of basic Carbonate of Magnesia with the proper amount of clean Asbestos Fibre as a binding element. It is extremely light in weight, easy to apply, fire-proof, mechanically strong. And is supplied in a wide range of sizes and weights.

K&M Distributors, located strategically throughout the country, are experts on the application of K&M insulating materials. Let them help you make important savings in your plant. Write us for further information.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA
IN CANADA — ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG AND VANCOUVER

A Pritchard **LPG STANDBY PLANT*...**



*Assures You Continued Use of CHEAP GAS FUEL

Wintertime gas supply failures and consequent production shutdown have made it necessary for many industries to consider the use of other types of more costly year round fuel supplies. Such costly conversions can be eliminated with a Pritchard Liquefied Petroleum Gas standby plant—which can be quickly and easily turned on without extra burner equipment and adjustments. Then come what may in the way of gas supply failures, your plant can continue in profitable operation during emergency periods. Throughout long periods of normal gas supply, you can continue the use of cheap gas fuel.
Before you convert to more expensive fuels, consult Pritchard's experienced gas engineers for estimates, specific details and recommendations. Write TODAY.

The Natural Gas Division of J. F. Pritchard & Co., also provides complete design, engineering and construction facilities for the control, treating or utilization of natural gas.

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With Your Own LPG Plant You Get These Important Benefits:

1. Propane-air possesses same heating qualities as natural gas and can be substituted in industrial systems without burner adjustments.
2. Fuel can be delivered by rail or truck at any time and stored for emergency use.
3. Complete or partial changeover can be made in a few minutes.
4. Butane or propane-butane, liquefied petroleum gas mixtures may be used interchangeably.
5. Pritchard Standby Plants can be independent units, complete within themselves.
6. Pritchard will design, engineer and construct to your specifications, covering all types of fuel.

THREE FUNCTIONS— Engineering, Construction, Manufacturing
IN FIVE FIELDS— Serving the CHEMICAL, POWER, PETROLEUM and GAS industries as well as providing specialized EQUIPMENT for all industries.

NATIONAL CONSTRUCTION ASSOCIATION — MEMBER

NATURAL GAS DIVISION

J. F. Pritchard & Co.

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CREATING *nothing* TO ASSURE LONG LASTING SERVICE

QUAKER HOSE IS VACUUM "PRE-TESTED" FOR STRENGTH OF WALLS . . . DURABILITY FOR POWER SERVICE

If it has the Quaker trade-mark it must be right . . . each type of hose must meet rigid "pre-tests" before it is shipped for service in the power industry. Scientific pre-tests that subject hose to torture-tests more severe than will ever be encountered in any installation are conducted right in Quaker plants.

One of these steps in "pre-testing" Quaker Hose is shown above. A vacuum test that puts Quaker Hose through the paces to provide rubber products for the power generation field that are second to none in quality.

This is only one of the eighteen rigid tests that raw materials and finished products must pass before receiving the Quaker stamp of approval. Yes, "pre-testing" of Quaker belting, hose and packings provides quality and long service . . . assures worthwhile dividends for your plant through less time-outs for maintenance, higher output, lower operating costs.

PACKINGS THAT PRESERVE POWER

Quaker pump packings are pre-tested for size, shape and quality to assure perfect fit, long service, maximum power.

BELTS THAT BOOST POWER

Quaker's complete line of transmission belting, for every power installation, is pre-tested and service-proved to provide sure-grip . . . slip less . . . save power.

QUAKER RUBBER CORPORATION

PHILADELPHIA 24, PA. • New York 7 • Cleveland 15 • Chicago 16 • Houston 1
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QUAKER

RUBBER PRODUCTS

QUAKER RUBBER CORPORATION PHILADELPHIA QUALITY SINCE 1885

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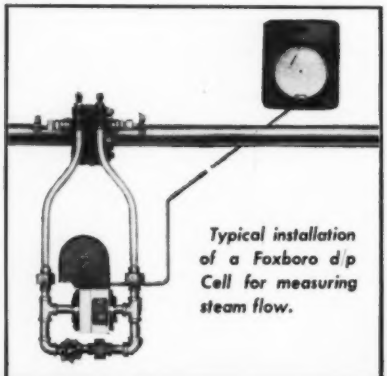
NEW!

Revolutionary

DIFFERENTIAL PRESSURE CELL

SIMPLIFIES MEASUREMENT OF STEAM FLOW

- *Positive, direct, force-balance operation.*
- *Zero displacement.*
- *No mercury used.*
- *Type 316 Stainless construction.*
- *1500 lb. operating pressure.*
- *Full overrange protection.*
- *Easy range change.*
- *Weatherproof.*



Typical installation of a Foxboro d/p Cell for measuring steam flow.

The new Foxboro d/p Cell is a flexible, easily-calibrated device operating on the highly accurate force-balance principle. *No mercury is used.* It transmits flow measurement to remote, conveniently-located pneumatic receiving instruments (indicating, recording, or controlling). It is small, weighs less than 20 lbs. . . .simple in construction. Absolute built-in overrange protection on both sides.

NO CONDENSING CHAMBERS NEEDED

Essentially zero displacement of the measuring element eliminates the need for condensing chambers. Because of its compact size, the d/p Cell can be installed close to the steam line . . . and the entire installation insulated where there is danger of lead line condensate freezing.

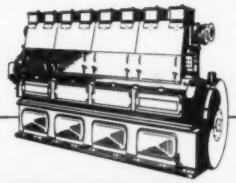
Learn all about this new, unique development. It may be the ideal solution to your measurement problem. Write for Bulletin 420. **The Foxboro Company, 114 Neponset Ave., Foxboro, Mass., U. S. A.**

FOXBORO
REG. U. S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING
INSTRUMENTS

DIESELS

assure consistently better economy...

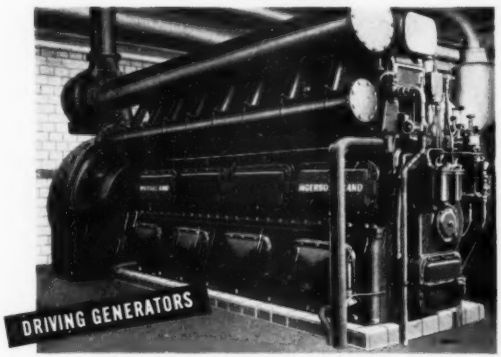


Ingersoll-Rand Diesels are heavy-duty, four-cycle engines that offer you *three* important savings. (1) Fuel consumption is low—less than 0.4 lb per bhp. (2) Compact design permits lighter foundations, reduced transportation and rigging costs. (3) Engineering and production excellence in every detail means lower-cost maintenance—and less of it.

Every Ingersoll-Rand machine is precision built to specifications that far exceed service requirements. Their extra *stamina* has proved its worth many times over As one long-satisfied user puts it, "You must build these machines to last *forever*."

Back of every machine is Ingersoll-Rand's 30 years of history-making achievement in building better Diesels —the pioneering that developed solid-fuel injection and progressively reduced machine weight and fuel consumption per horsepower.

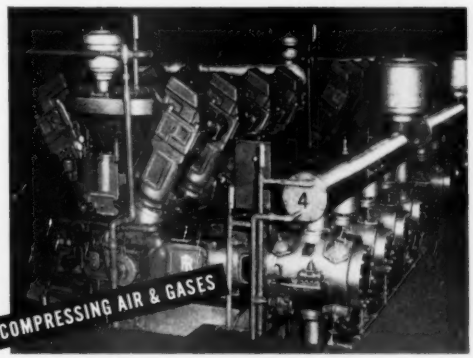
Write today for complete information on Ingersoll-Rand Diesels.



Ingersoll-Rand Diesels, with a medium speed of 720 rpm, permit the use of smaller, more efficient and less costly generators than are required with slower-speed engines.

Type "S" Diesels are built in 3, 4, 5, 6, 7, and 8 cylinder sizes, for 225 to 600 hp.

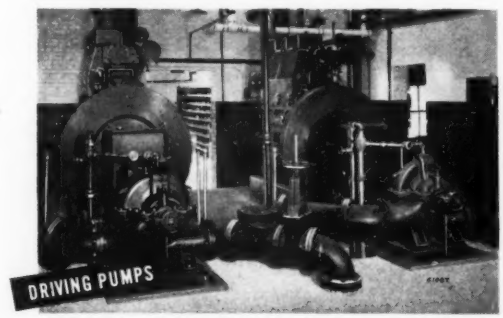
Type "SS" supercharged Diesels—built in 6, 7, and 8 cylinder sizes for 675 to 900 hp—provide maximum economy of space and weight, by producing 50 per cent more power than unsupercharged engines.



The Ingersoll-Rand Type XVO Diesel-engine-driven compressor is a compact unit that assures maximum compressed air output per pound of fuel. With one gallon of fuel oil, the XVO compresses 5600 cu ft of air to 100 lb pressure.

The compactness and smooth-running balance inherent in its double-acting crosshead design permits the use of small and inexpensive foundations.

The actual free air delivery at 100 psi is 335, 700, 1075 and 1450 cfm for 2, 4, 6, and 8 cylinder units respectively.



The matched coordination of Ingersoll-Rand Type "S" or "SS" engines and Ingersoll-Rand centrifugal pumps assures the utmost in pumping economy—for pipe line jobs or in pumping stations. Their coordinated design gives you a Diesel-powered pump free from critical speeds in the operating range. Flywheels, shafts, impellers, couplings and gears are all designed to keep liquids moving at minimum overall cost.

DIESEL ENGINES

Ingersoll-Rand

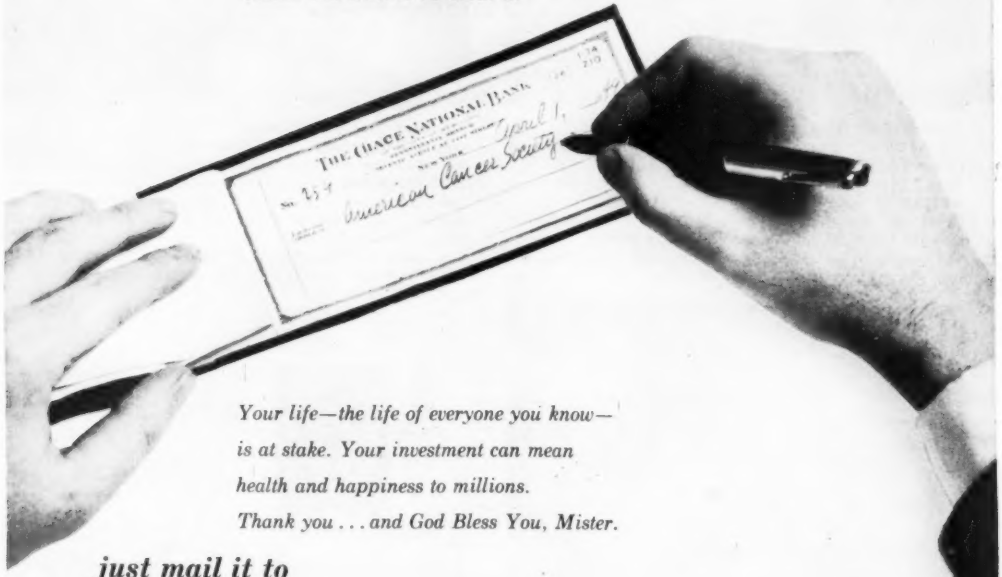
312-7 **11 BROADWAY, NEW YORK 4, N. Y.**

COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO BLOWERS
CONDENSERS • CENTRIFUGAL PUMPS • OIL & GAS ENGINES

God bless you, mister

...thousands of Cancer patients are grateful to you!

Cancer's annual toll of 200,000 lives is grim proof of the need for your continued generosity. The money you contribute to the American Cancer Society helps pay for the development of methods of treatment which are now saving about one-quarter of the people who are stricken with Cancer... people who might otherwise have died. Your money supports the work of more than a thousand specialists who are fighting to find the cause and cure of Cancer. And it finances a vast education program that trains professional groups, tells the public how to recognize Cancer and what to do about it.

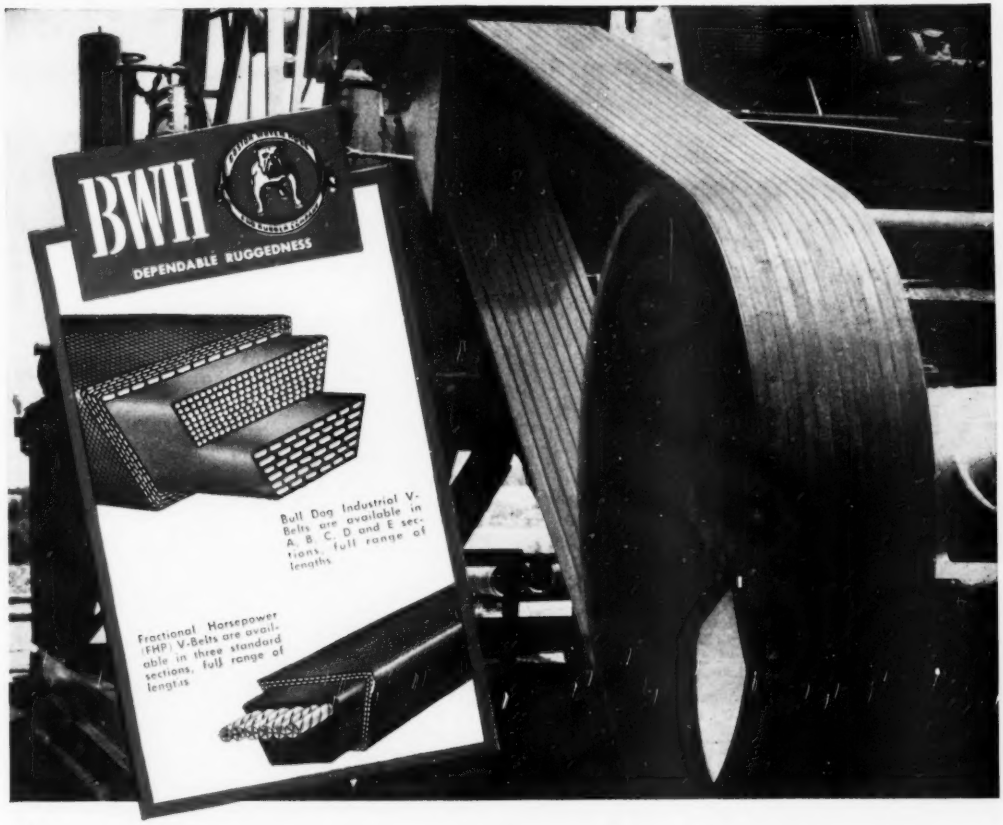


Your life—the life of everyone you know—is at stake. Your investment can mean health and happiness to millions. Thank you... and God Bless You, Mister.

just mail it to

CANCER

Just write "CANCER" on the envelope containing your contribution. It will be delivered to the American Cancer Society office in your state.


BWH
DEPENDABLE RUGGEDNESS
Bull Dog Industrial V-Belts are available in A, B, C, D and E sections, full range of lengths
Fractional Horsepower (FHP) V-Belts are available in three standard sections, full range of lengths

LESS SLIPPAGE! COOLER RUNNING! LONGER LASTING!

NO WONDER THERE'S INCREASING DEMAND FOR

RUGGED BULL DOG V-BELTS

On tough jobs where a dependable V-Belt drive is of utmost importance, operators today are specifying Bull Dog V-Belts.

These new BWH "titans" have consistently proved they deliver the kind of steady, trouble-free service that speeds production and slashes maintenance costs.

Here's why there's less slippage with Bull Dog V-Belts, fewer shutdowns for adjustments, greater long-term economy in their use:

1. *Exclusive Bull Dog Cord Section Has Higher Tensile Strength,* able to carry the load and absorb shock.

2. *Low Stretch,* because exclusive Bull Dog Cords are processed in a new way. As a result, there's less slippage, fewer adjustments, longer belt life.

3. *Cool Running,* thanks to quality-controlled compounds developed in BWH laboratories, which do not crack or deteriorate under the most severe flexing.

4. *Wear-Resistant Covers* of heavy, bias-cut fabric, to protect heart of belt from dirt, grease and moisture.

Bull Dog V-Belts are one of many famous products manufactured by BWH. When you need industrial rubber goods, look to BWH for products of dependable ruggedness, to BWH distributors for dependable service.

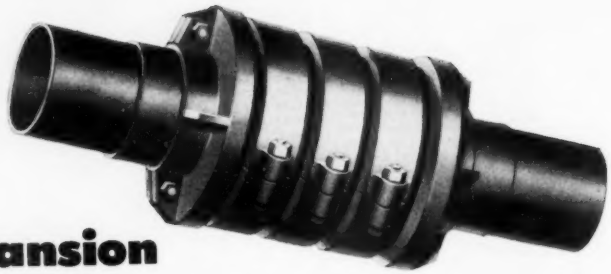
HAVE YOU A JOB WHERE STAMINA COUNTS?
Bring us your toughest problems. We're specialists in solving them. Consult your nearby BWH distributor or write us direct.

Another Quality Product of

BOSTON WOVEN HOSE & RUBBER COMPANY

Distributors in all principal cities

PLANT: CAMBRIDGE, MASS., U. S. A. • P. O. BOX 1071, BOSTON 3, MASS.



wherever pipeline expansion is a PROBLEM

CMH Expansion Joints are the cost-saving, trouble-saving solution!

Common expansion joint problems of leakage, repacking, space limitation and complicated, costly installations are solved with CMH Expansion Joints. Compact, inline units, CMH Expansion Joints are easy to install—actually, they are standard piping sections. They require *no* maintenance . . . **and they don't leak.**

CMH Expansion Joints are available in either stainless steel or copper . . . Free-Flexing units for pressures up to 30 psi . . . Controlled-Flexing units for pressures up to 300 psi . . . **special units for unusually high pressures.**

Selection of the correct CMH Expansion Joint has been simplified to a matter of charts from which the joints necessary to meet your requirements may be chosen quickly and easily. CMH'S "Engineered Application Service" is also available to assist on unusual installations.

Full data on CMH Expansion Joints including the charts mentioned above are given in Bulletin EJ-49. Ask for a copy.

CMH—ONE dependable source for every flexible metal hose requirement

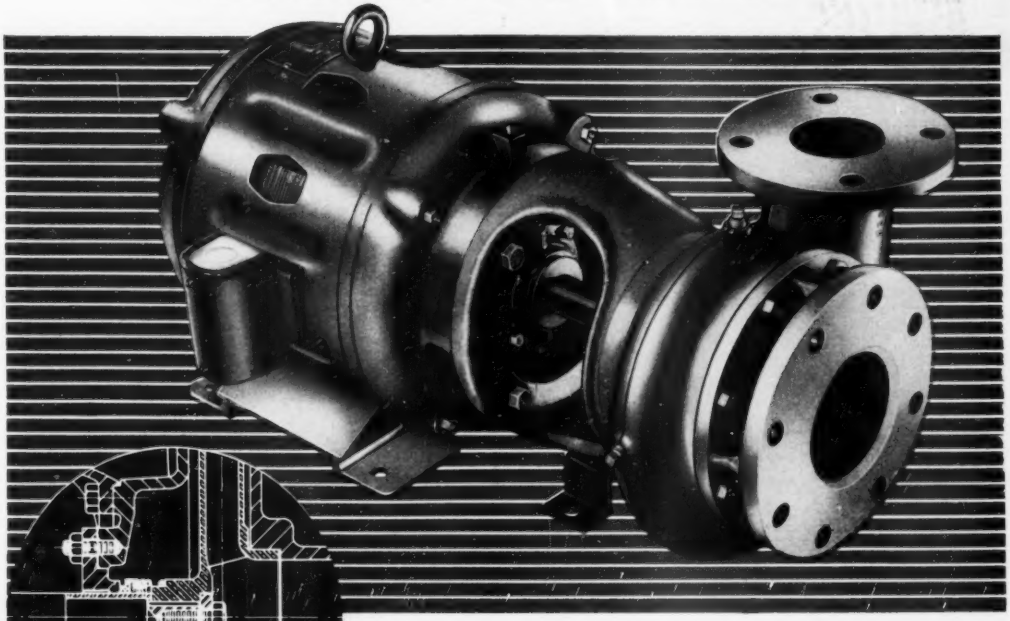
• CMH manufactures all standard types of flexible metal hose, both convoluted and corrugated, in a variety of metals; expansion joints for piping systems; stainless steel and brass bellows; various conduits and special assemblies of these components.

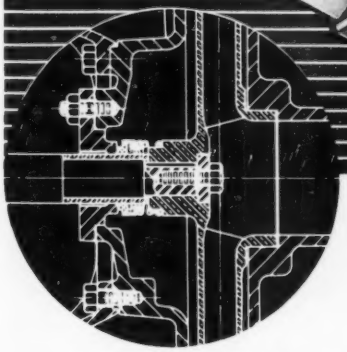
CHICAGO METAL HOSE CORPORATION
EXPANSION JOINT DIVISION

Leaders in the Science of Flexonics
MAYWOOD, ILLINOIS
Plants at Maywood, Elgin and Rock Falls, Illinois
In Canada: Canadian Metal Hose Co., Ltd., Brampton, Ontario
FLEXON identifies CMH products which have served industry for more than 47 years.

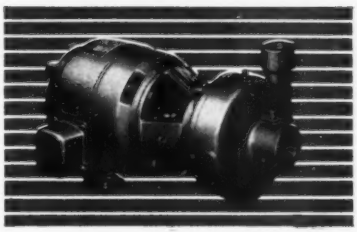
NO DRIP FROM THIS IMPROVED PACKLESS PUMP

MECHANICAL SEAL ENDS USUAL PUMPING TROUBLES





Cross-section of B & G Mechanical Seal



B & G SERIES 1522 CENTRIFUGAL PUMP

Another B & G Pump with outstanding qualifications! Seven big features: Standard Motors—Mechanical Seal—Spring type Flexible Coupling—Interchangeable Parts—Compact Design—Easy Servicing—Competitive Price. Available as all-iron, bronze fitted or all-bronze units.

B & G SERIES 1531 CENTRIFUGAL PUMP

It will be worth your while to look into the outstanding advantages of the B&G Series 1531 Centrifugal Pump. This unit features a Mechanical Seal which assures trouble-free operation under tough pumping conditions.

The Mechanical Seal adds materially to length of service, especially where the pumped liquid contains foreign matter which is damaging to the ordinary stuffing box. The Seal is *self-lubricating* and eliminates the customary leakage through the packing gland.

You'll also like the painstaking workmanship found in the B & G Series 1531 Pump. All parts are machined to rigid specifications and accurately assembled. Quick and easy replacement in the field is assured by positive uniformity throughout. High hydraulic efficiency is obtained throughout the capacity range and all pumps are shop tested for conditions of head and capacity specified.

Send for complete engineering data.

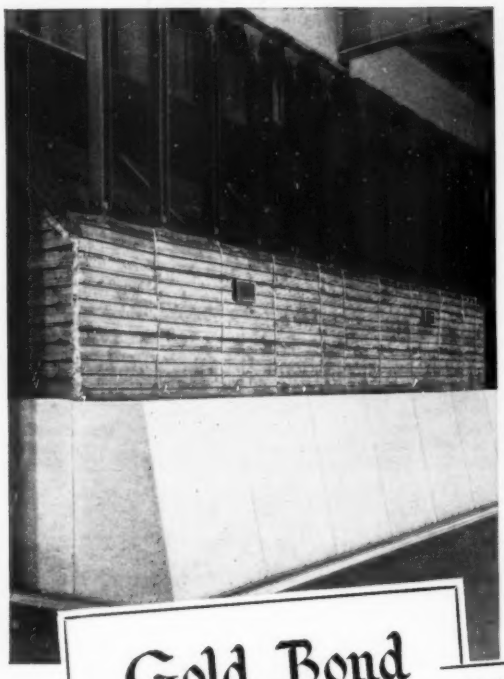
SEND FOR THESE CATALOGS OF B & G CENTRIFUGAL PUMPS

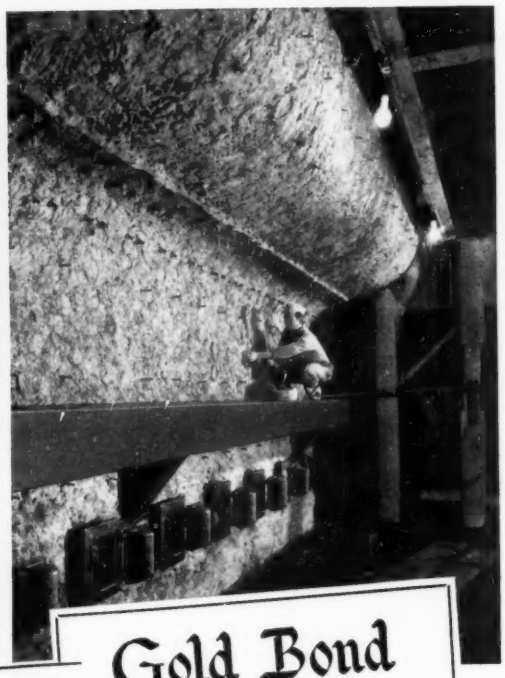
Hydro-Flo® CENTRIFUGAL PUMPS

BELL & GOSSETT CO. • Dept. AY-36 • Morton Grove, Illinois

Here's Specified Economy

IN HIGH TEMPERATURE INSULATION!





Gold Bond FLEXFELT BLANKETS

Effective up to 1250° F. Made from fireproof mineral wool, felted and reinforced on both sides by metal fabrics bound together by tie wires.

PLUS

Gold Bond No. 340 INSULATING CEMENT

Effective up to 1800° F. Offers four advantages! Superior adhesive qualities, greater coverage, no shrinkage cracks, greater thermal efficiency.

INSTALLATIONS in the Buffalo Niagara Electric Huntley Station are shown above. The picture on the left illustrates the application of Flexfelt Blankets to the giant air heater for the newly installed 875,000 lbs. per hr. Steam Generator. Produced by the most modern methods, Flexfelt Blankets have longer, tougher fibres, resulting in greater thermal efficiency, and resistance to moisture absorption and vibrations.

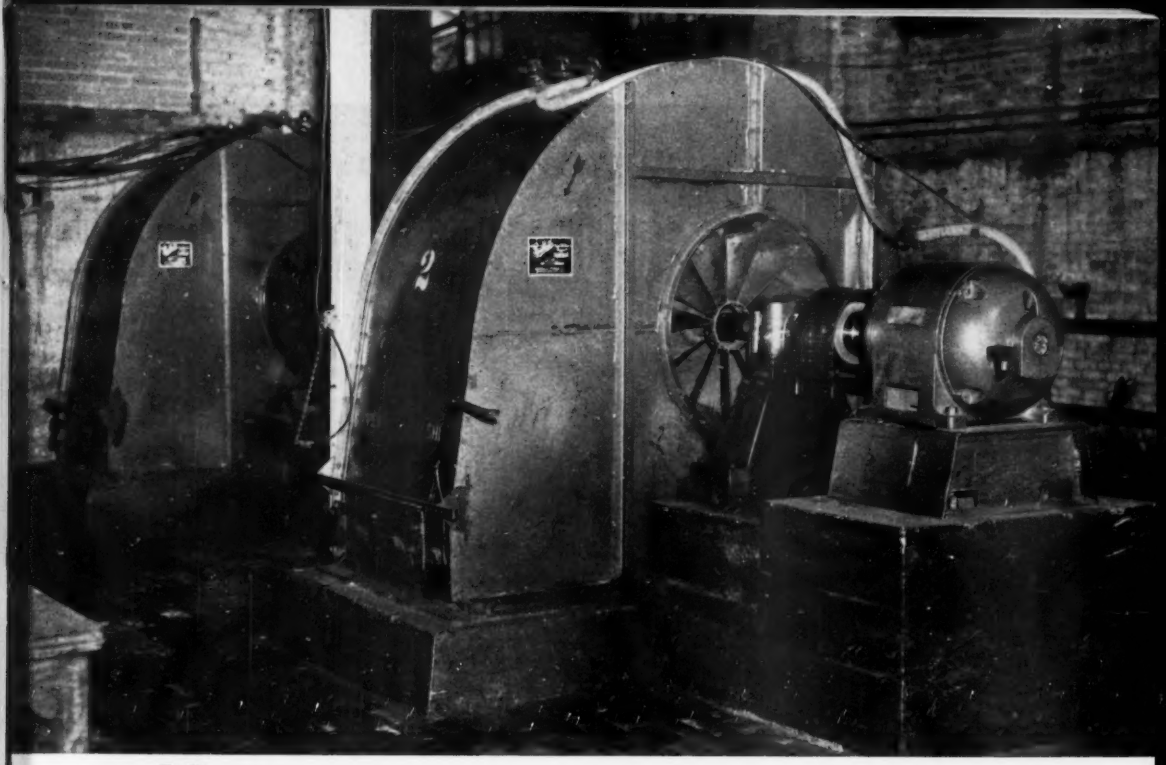
The picture at right shows the application of Gold Bond #340 Insulating Cement on the furnace wall. This fireproof cement is easily applied and gives high coverage (1 lb. will cover about 1 sq. foot ½" thick after drying). It conserves heat and power, soon repaying its cost in increased efficiency and fuel savings.

Write today for detailed information to

NATIONAL GYPSUM COMPANY

Industrial Insulations P-94

Buffalo 2, New York



Here's the LONG-LIFE Construction you get in "Buffalo" DRAFT FANS

If you've ever seen "Buffalo" Draft Fans, you know what we mean by "husky in the right places"! If you've seen extra-heavy plate that goes into their housings and wheels—their mighty shafts and rugged bearings — their sturdy blades properly shaped for stiffness and maximum air moving—you know why "Buffalo" Forced Draft is the kind that KEEPS combustion efficient! Slow rotor speed, too, plus inherent high efficiency in the fan means adequate draft at less power cost and less noise.

Put "Buffalo" on your draft job—induced or forced draft—and get the service you can count on at lower cost, year after year!

5th Edition!

A "*MUST*" FOR EVERY ENGINEER!

Fan Engineering, 5th Edition, offers you 808 pages of latest facts on air problems, including: fans, air flow, sound laws, heat, cooling, drying, air properties, humidity, air conditioning!

ORDER YOUR COPY NOW

Price **$6.00** Postpaid in U. S. A.

It PAYS to have the facts on draft fans! Write for Bulletins 3113-A (forced draft) and 3190-B (induced draft) and see why heavy-duty, high-efficiency construction saves on power-producing costs!

"Buffalo" "First For Fans"

PERMANENT SATISFACTION IN AIR HANDLING

VENTILATING AIR TEMPERING
FORCED DRAFT HEATING
AIR WASHING INDUCED DRAFT
COOLING EXHAUSTING
PRESSURE BLOWING

BUFFALO FORGE COMPANY

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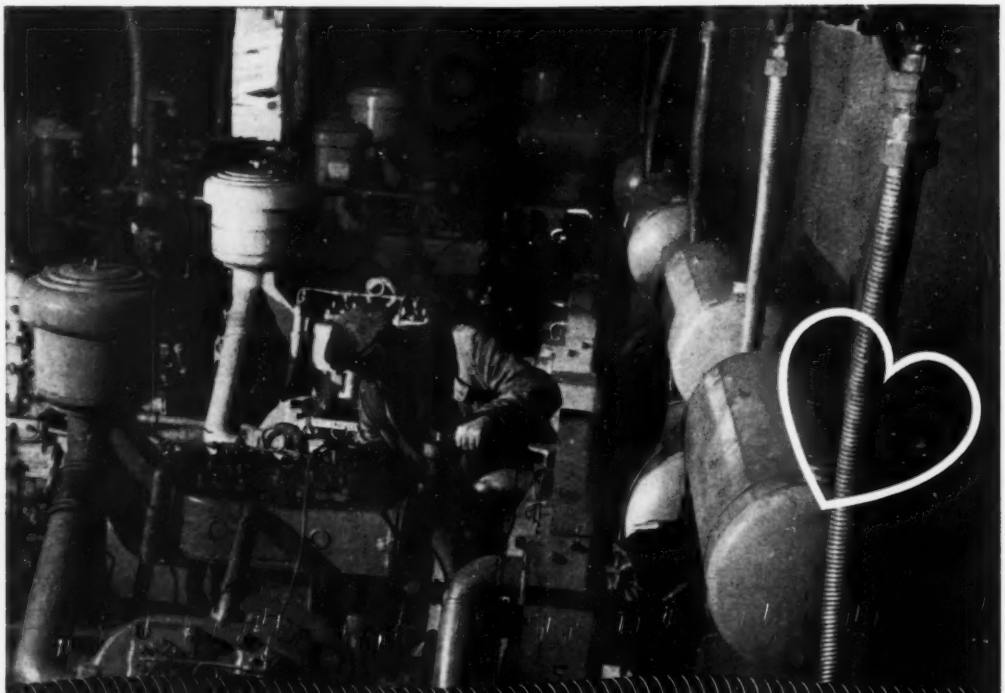
CANADIAN BLOWER & FORGE CO., LTD., KITCHENER, ONT.
Branch Offices in all Principal Cities



TAKES THE "SHAKES" OUT OF AIR LINES

Penflex Flexible Metallic Hose prevents vibrations on compressed air lines, easily... safely... economically

With a mighty roar, 15 diesel-powered air compressors pump a steady air supply for air tools and equipment used on a world-known project. During the installation of these powerful compressor units, a method was required to prevent constant vibration from being transmitted to the rigid air lines.

That's where Penflex "Flexineering" service paid off. By using 3" Penflex interlocked flexible metal hose as connectors between compressors and pipe lines, the "shakes" are eliminated. Tight as a pipe, but flexible, Penflex hose "soaks up" constant vibration, assuring smooth air power . . . leak-proof, low-cost service. Penflex hose is also used to carry off obnoxious diesel exhaust, preventing dangerous leaks and vibration.

When your plant is troubled with flexible tubing problems, whether they pertain to production, maintenance or high operating costs, let Penflex "Flexineering" find the right answer. As America's oldest manufacturer of flexible hose, Penflex offers helpful layout-design service on flexible tubing applications to all industries. For flexible metallic hose, tubing, or couplings from 1/8" I.D. and up . . . for handy, time-saving automatic barrel fillers and pneumatic rivet passers . . . for the finest in engineering service, call on Penflex. Write today, to . . .

PENNSYLVANIA FLEXIBLE METALLIC TUBING CO.
7238 Powers Lane **Philadelphia 42, Pa.**
Branch Sales Offices—BOSTON • NEW YORK • CLEVELAND • CHICAGO • HOUSTON • LOS ANGELES

Penflex... HEART OF INDUSTRY'S LIFE LINES

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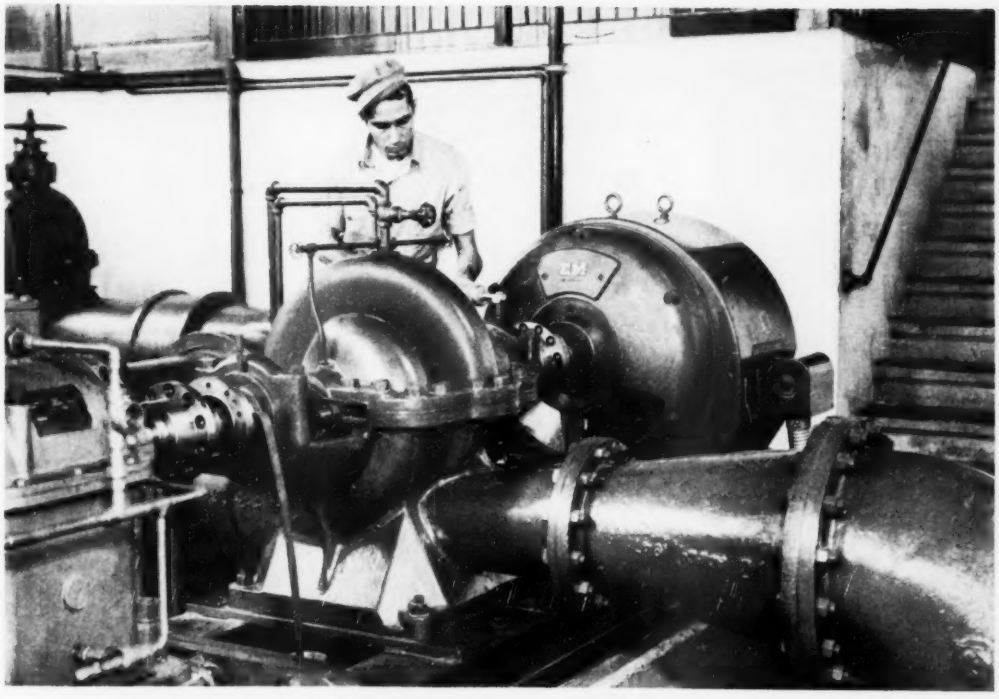


History repeats itself

WITH RESULTS OF GREATEST IMPORTANCE TO USERS OF HEAVY-DUTY INDUCTION MOTORS

●Running with cool, quiet efficiency on some of industry's toughest jobs, E-M Heavy-Duty Squirrel Cage Induction Motors are furnishing on-the-job proof that there are differences in induction motors . . . in their reliability, economy, maintenance.

The development of these motors has been a case of history repeating itself . . . of bringing to the design and construction of induction motors the same kind of specialized large-motor creative engineering that has made Electric Machinery the headquarters for pacemaking developments in synchronous motors for nearly forty years. The long-lasting, quiet-running rotors of E-M Induction Motors, their wear-resistant, anti-friction or modern 1 to 1 ratio sleeve bearings; long-life, multi-layer insulation and job-engineered external protection are things that pay off in dependable and economical operation.

For example, the job-engineered protection of a drip-proof shield on the water pump motor shown above (400 h.p., E-M Induction Motor in Wichita plant of Kansas Water Company) eliminates any danger of damage and breakdown from dripping water or other falling material. Splash-proof and fully enclosed protection may also be obtained.

These great induction motors are the answer to the need for electric drives that can be relied on to serve long and well on the toughest, heavy-duty jobs. For full information, write for our publications 189 and 190.

ELECTRIC MACHINERY MFG. COMPANY
Minneapolis 13, Minnesota

1300-TPA-2083

SPECIALISTS IN
BIG MOTOR ENGINEERING

—Dependability
—Economy
—Long Life

WIDE SELECTION:

Single and Multi-stage
Pressure range: 0 to 1200 P.S.I.
Capacities: 5 to 50,000 G.P.M.
Types: Horizontal and Vertical
Impellers: Open or enclosed
Casings: Horizontal or Vertical Split, cast iron or bronze
Bearings: Sleeve or ball-bearing

Warren makes pumps *exclusively*. Specialized experience has taught us how to engineer and build the most efficient pump for your job. Thousands of Warren centrifugal pumps are in use by leading companies. Many reorders prove their dependability.

Why be satisfied with less than a Warren? Send an outline of your problem and let us suggest the answer.

WARREN RECIPROCATING PUMPS

Horizontal and Vertical single piston
Horizontal and Vertical duplex piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.

P-18

WARREN STEAM PUMP COMPANY, INC. SERVICE EVERYWHERE **WARREN, MASS.**

WARREN PUMPS

CENTRIFUGAL AND RECIPROCATING

For: Power Plants --- Chemical Plants --- Paper Mills --- Food Industries --- Metal Working --- Oil and Mining Services

When you buy a boiler, do you surrender your right to choose the stoker?

If you are considering the purchase of a new boiler, make sure you *retain* the privilege of selecting the Spreader stoker of your own choice. And look *closely* at Spreader stokers! Be certain you get these 4 features: 1. *Clogless feeding* of wet or dry coal; 2. *Even* coal distribution; 3. A cinder return system that works; and 4. *Adjustable* overfire air.

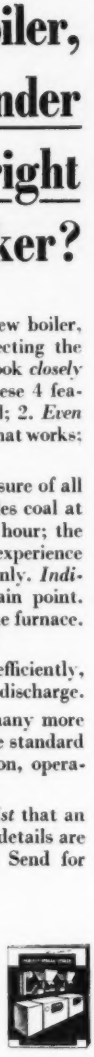
With Æ Perfect Spread Stokers, you are sure of all four—*and more.* The exclusive feeder handles coal at a rate adjustable from 50 to 7500 lbs. per hour; the overthrow impeller was developed—after experience with many designs—to spread the coal evenly. *Individual* cinder returns tap *every* cinder drain point. Each return has its own Venturi air jet to the furnace. And every overfire air nozzle is adjustable.

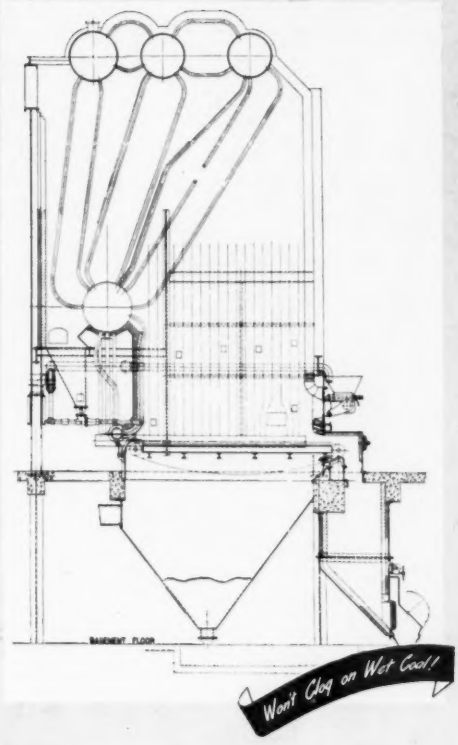
You can burn less costly lower grade coal efficiently, reliably and with better control of stack discharge.

Besides these 4 big features there are many more that make the Æ Perfect Spread Stoker the standard of comparison for engineering, construction, operation, performance and economy.

No matter who supplies your boiler, *insist* that an Æ Perfect Spread Stoker be installed. Full details are contained in our new illustrated catalog. Send for your free copy today.

FREE! *Get this informative catalog on Æ Perfect Spread Stokers now. Write Dept. 10.*





1948 Æ Perfect Spread Stoker installation in the Ohio plant of a large automobile manufacturer. It consists of 4 Æ Perfect Spread Stokers, of the Continuous Ash Discharge type. Each unit has a normal capacity of 60,000 lbs. per hour, and maximum capacity of 70,000 lbs. per hour steam output.

OTHER Æ PRODUCTS—*Taylor Stokers—Lo-Hed Electric Hoists & Car Pullers—Hele-Shaw Fluid Power —Marine Deck Auxiliaries.*

Æ PERFECT SPREAD STOKER

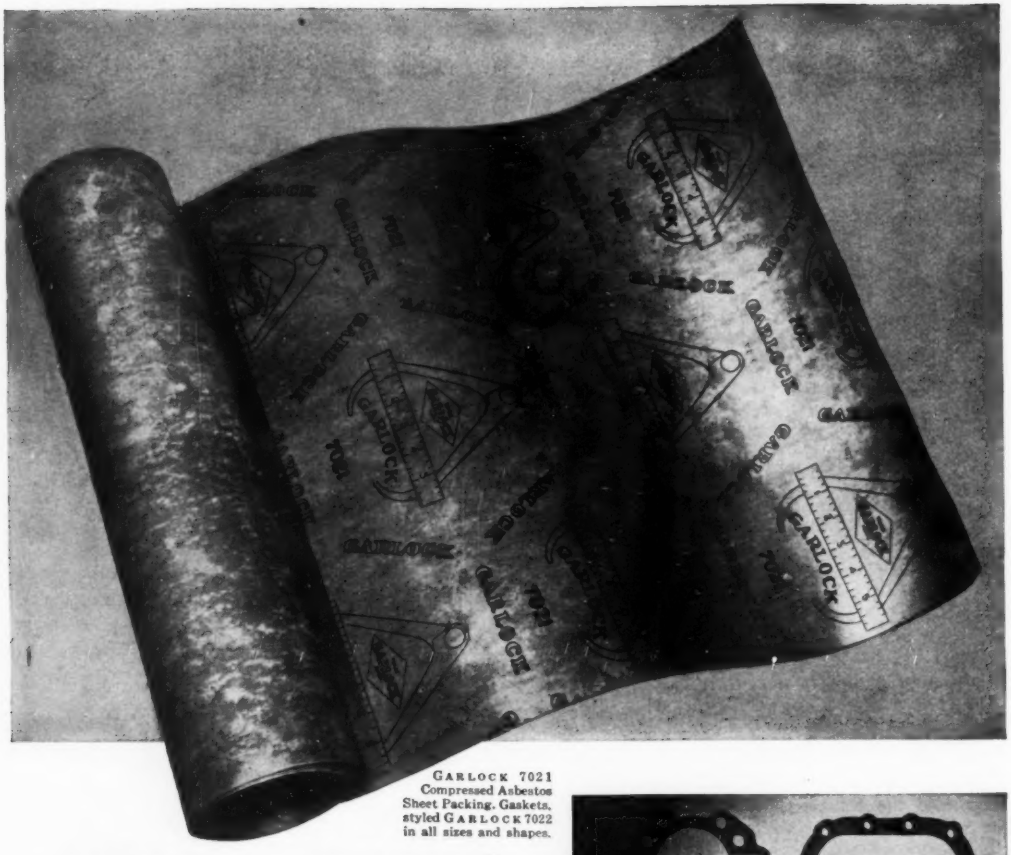
with Traveling, Dumping or Stationary Grates

A PRODUCT OF

AMERICAN ENGINEERING COMPANY

2400 Aramingo Avenue, Philadelphia 25, Pa.

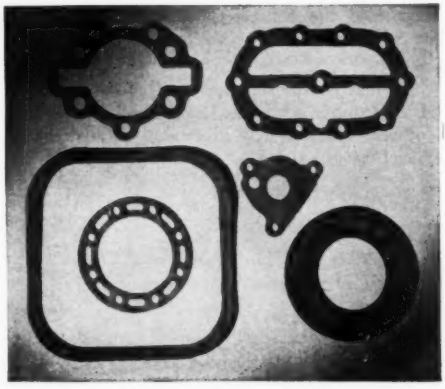
New York Office—75 West Street, N.Y., N.Y. • *In Canada:* Affiliated Engineering Corporations, Limited, Montreal and Toronto



GARLOCK 7021 Compressed Asbestos Sheet Packing. Gaskets, styled GARLOCK 7022 in all sizes and shapes.

STRONG AND TOUGH!

GARLOCK 7021 is a strong, dense, compressed asbestos sheet. This gasketing material is sufficiently compressible to compensate for normal irregularities in flange faces, but resistant to plastic flow under heavy bolt loads. Withstands extreme pressures and high temperatures. Specially recommended for severe oil and steam service.

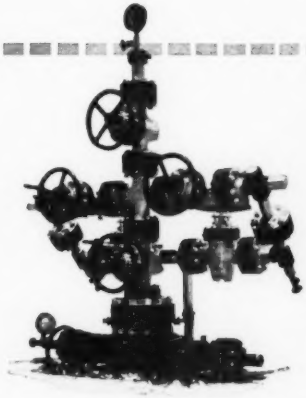


THE GARLOCK PACKING COMPANY
PALMYRA, N. Y.
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

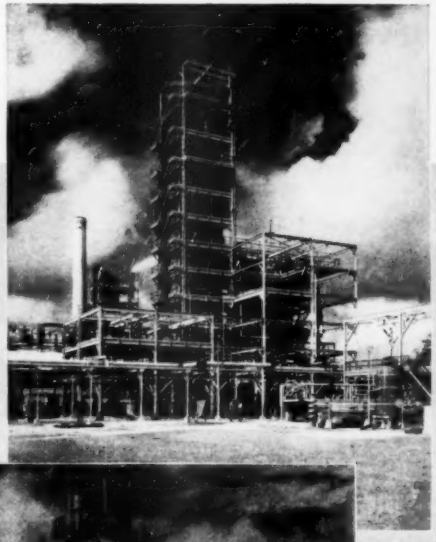
GARLOCK 7021

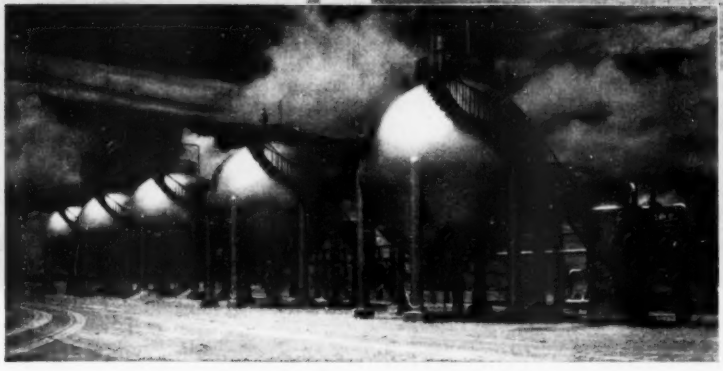
COMPRESSED ASBESTOS GASKET SHEET

FROM WELL HEAD to FINISHED PRODUCTS



Our work for the process industries includes engineering design and construction of a wide range of installations for natural gas, refining and chemical operations from well head to finished products.





STONE & WEBSTER ENGINEERING CORPORATION

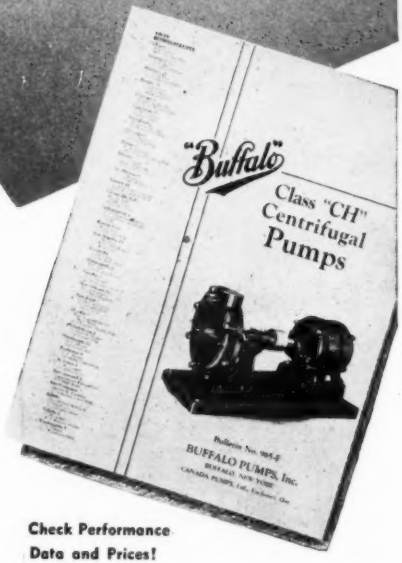
A SUBSIDIARY OF STONE & WEBSTER, INC.

—and you START SAVING the minute you buy it!

The moderate first cost of "Buffalo" Type CH Pumps is just one of the many features which recommend it as one of the greatest pumping values ever offered. Its open impeller design is particularly suited to handling gritty water—yet gives higher efficiencies than most similar pumps using enclosed impellers. These efficiencies are obtained because smaller motors can be used.

And these pumps are built to standard jigs and gauges—interchangeable. Another fact which users will readily appreciate is the adjustable discharge (eight positions) without disturbing intake piping. Note, too, the bearing next to pulley-coupling—it's ring-oiling for superior lubricating qualities.

If you need an open impeller pump, you can't find a better buy than the CH.



Check Performance Data and Prices!

Bulletin 965-F, above, gives all construction data on page 4—sectionals and performance data on pages 5-8, including three models available for heads up to 120 ft. Write for this bulletin and prices—see what a value CH Pumps are for pumping gritty water.

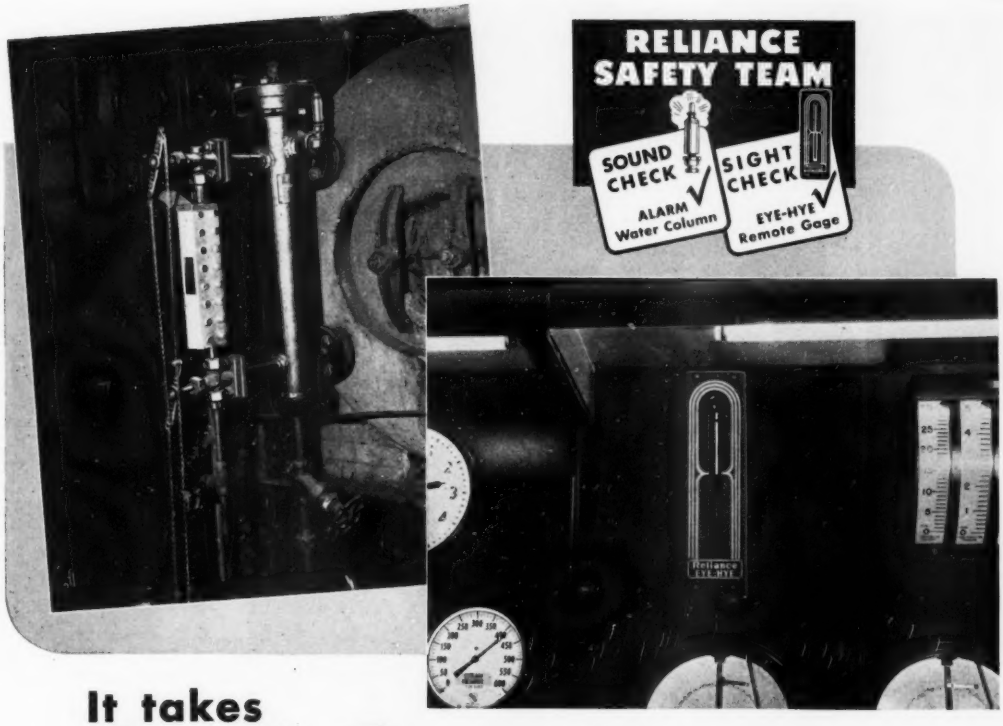
"Buffalo" PUMPS

BUFFALO PUMPS INC.

488 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

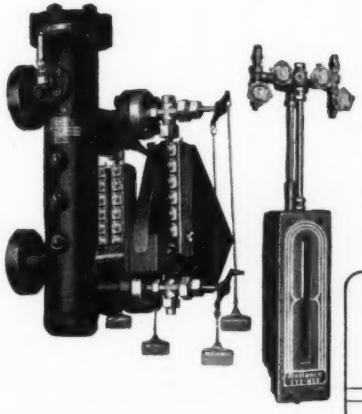
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



It takes *Double Supervision* to assure full safety from boiler water level failure

Reliance Alarm Water Column

EYE-HYE Remote Reading Water Level Gage



Prevent boiler outage and expensive water level accidents. Have *adequate* boiler water supervision . . . so easy to obtain with the Reliance Safety Team. The automatic alarm water column, originating with Reliance back in 1884, has saved many thousands of boilers from explosion or damage. Its sensitive mechanism acts instantly to warn operators when dangerously low or high water levels develop.

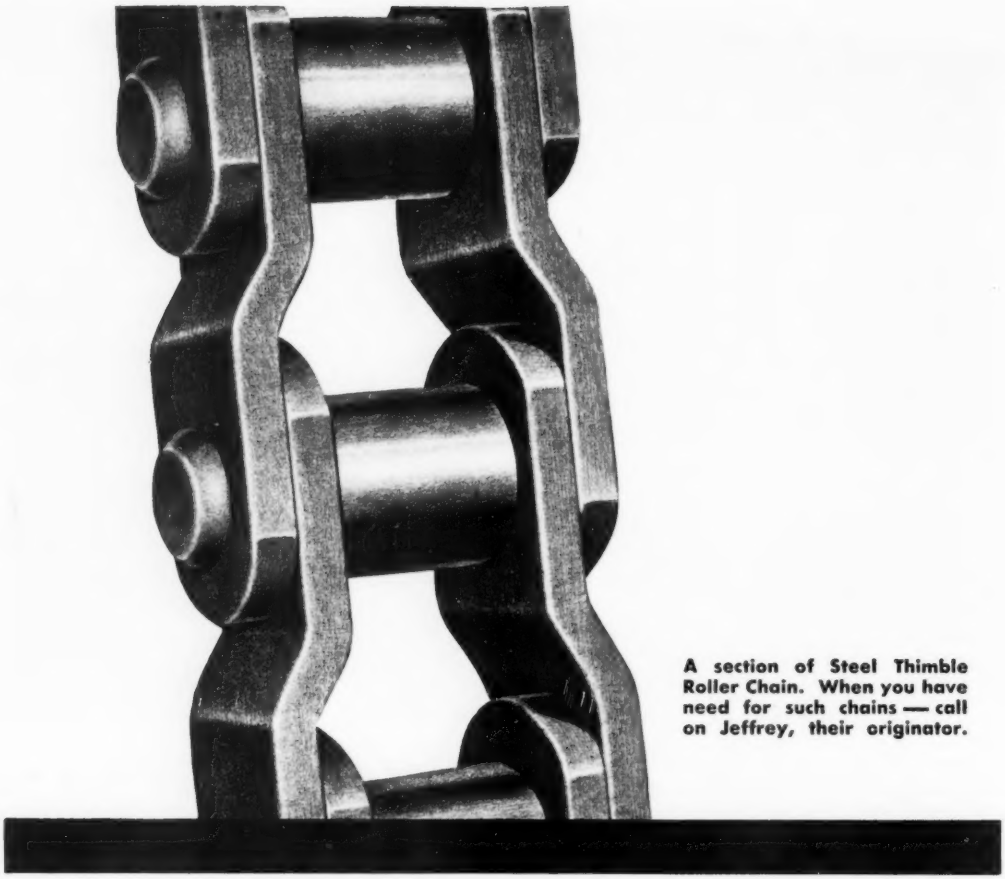
That's the final warning. You don't want to hear it, so you make doubly sure water levels are safe by keeping tab on the gage reading. But gages high on the boiler may be hard to reach, or difficult to see clearly. EYE-HYE Remote Reading Gage is the answer. Mount it at eye height, on wall or instrument panel. Its illuminated green indicator is hard to miss.

EYE-HYE is a sturdy, dependable instrument, yet one of the most simple. Calibration set at the factory to suit your conditions . . . can't be tampered with. Ask your nearest Reliance Representative about the Safety Team, or write to the factory.

BOILER SAFETY DEVICES since 1884

Reliance®

THE RELIANCE GAUGE COLUMN CO. · 5902 CARNEGIE AVENUE · CLEVELAND 3, OHIO



A section of Steel Thimble Roller Chain. When you have need for such chains — call on Jeffrey, their originator.

CHAINS are important but often they are given little consideration until all else is accounted for. Whether for conveyors, elevators, other unit machinery or for driving purposes — correctly designed chains are highly essential. Chain is one of our earliest products — we know how to build it exceptionally well. A complete line — also attachments, sprockets and transmission machinery.

THE JEFFREY MANUFACTURING COMPANY

Established 1877

932 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

JM

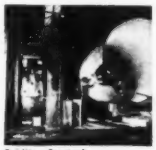
Baltimore 2
Birmingham 3
Boston 16
Buffalo 2
Chicago 1
Cincinnati 2
Cleveland 13
Denver 2
Detroit 13
Harlan
Houston 5
Huntington 19
Jacksonville 2
Milwaukee 2
New York 7
Philadelphia 3
Pittsburgh 22
St. Louis 1
Salt Lake City 1
Scranton 3

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

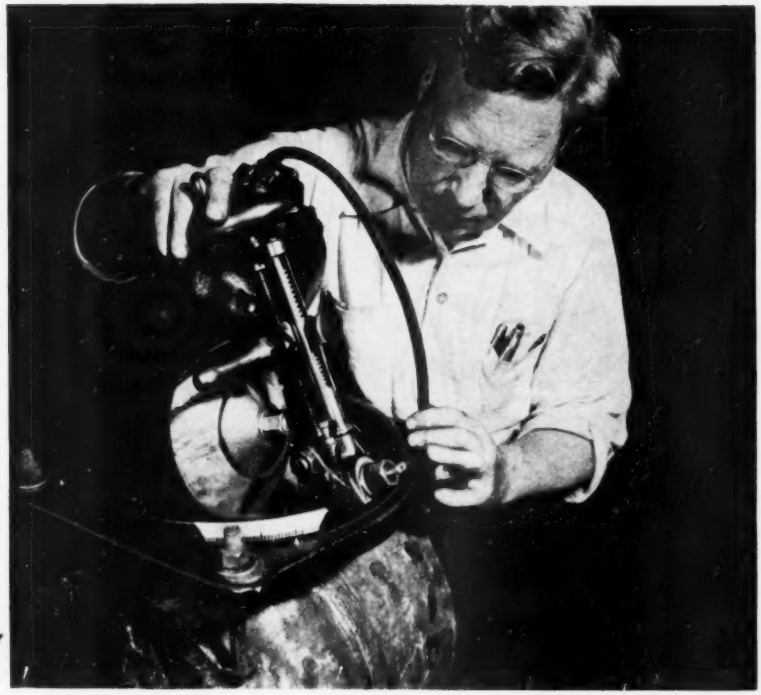
Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.



Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



Gouging that pays off!

GOUGING has an unpleasant connotation in most lines of business. But when it comes to power piping, "gouging" means longer life and better service from pipe because it shows you what you can't see by just peering at a pipe installation or scrutinizing a manufacturer's stamp.

Let's take a peek at this thing you can't see. It all starts out with the familiar weld-prober shown above. This portable piece of equipment gouges out boat-shaped samples from pipe that is actually in service position. The holes it leaves are carefully refilled by welding and service quickly resumed.

It's what happens to these samples that is important; that's one of the major reasons Kellogg power piping is held in such high repute.

For some time these gouged-out samples have been used in an exhaustive study of the eccentricities of graphitization – the metal disease that attacks high temperature and high pressure piping during service life and seriously impairs its original strength.

There are some seventy-five talented technicians actively engaged in metallurgical study at Kellogg's Jersey City Laboratories. One of their principal programs is the study of graphitization. Much data has been gathered . . . much more will be forthcoming. Everything that is already known goes toward providing better power piping.

Such invisible technical advancement is duplicated throughout every phase of power piping work—from the use of exclusive stress analyzing equipment to the testing of welds on the actual installation site. It is the important advantage you can't see when you buy power piping from M. W. Kellogg.

To master temperature, pressure and chemicals use

M. W. KELLOGG

process equipment

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING
PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

NEW YORK • JERSEY CITY • BUFFALO • LOS ANGELES
TULSA • HOUSTON • TORONTO • LONDON • PARIS

KELLOGG

"Me . . . stock all those endless V-Belt sizes?"

"Not since I use VEELOS"

"I can replace any V-belt in our plant with just these reels of Veelos."

That's a typical Veelos user telling you how Veelos cuts V-belt inventory. If you use O, A, B and C widths, four reels of Veelos give you a choice of more than 316 sizes. Use only A and B? Then two reels are all you need.

Buying matched sets of endless V-belts is costly. Forget it with Veelos. Forget, too, belt deterioration and obsolescence. Veelos on reels saves storage space . . . simplifies stock records.

Veelos is quickly and easily installed. On drives with fixed centers or outboard bearings, Veelos is installed without moving the motor or dismantling the machine. It provides substantial savings in installation and maintenance costs.

SEND FOR FREE VEELOS CATALOG. It shows how you can benefit from the many important advantages of Veelos. Fully illustrated. Complete engineering data. Write for it.

MANHEIM MANUFACTURING & BELTING COMPANY
MANHEIM, PA.

VEELOS
THE LINK
V-BELT

ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

Made in all standard sizes, fits all standard grooves. Packaged on reels in 100-foot lengths. Sales engineers in principal cities; over 300 distributors throughout the country. Veelos is known as VEELINK outside the United States.

"ZERO" SOFT WATER

from your Hot-Process unit

without chemical after-treatment

*Process Patent Pending

easily added to your present equipment!

Operates economically at temperatures up to 220°F . . . on waters having a pH as high as 10.5. Ideal unit for after-treatment of hot-process lime-soda effluent . . . to remove last traces of residual hardness. Unit is approximately same size as hot-process filter. A product of ILLCO-WAY ionXchange research.

- **provides "zero" soft-water, regardless of variations in the hot-process effluent**
- **decreases the excess dosages required for straight hot-process**
- **reduces amount of chemicals required in boiler (none are needed for hardness control)**
- **eliminates frequent adjustment**
- **eliminates deposits (which result in "plugging") in valves, feed-pumps, feed-lines, heaters**
- **chemical savings alone will normally pay for equipment in less than two years**

Write for full details today

Illco-Way and Elgin representatives in principal cities

COPR. 1949

ILLINOIS WATER TREATMENT CO., 853-4 Cedar St., Rockford, Illinois • 7310-NN4 Empire State Bldg., New York

Together to serve you better!

ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

Elgin

ELGIN WATER CONDITIONING

Services and products of Elgin Softener Corporation have been added to those of ILLCO-WAY—thus broadening our range to include Elgin Zeolite Water Softeners, Water Treating Chemicals, Filters, and the complete line of Elgin Water Conditioning Systems for every need.

ENGINEERING AND EQUIPMENT—DE-IONIZERS for process water treatment and treatment of liquids and solutions other than water; waste treatment; reclamation of specific constituents. DE-ALKALIZERS: Boiler feed (external); Bottling water. SOFTENERS: Industrial, Domestic. FILTERS, etc.

for continuous heavy-duty operation

O-CE COMPRESSORS

When the demand is for a continuous, economical supply of air, the CP motor-driven O-CE COMPRESSOR is unsurpassed.

Quick-acting Simplate valves minimize power consumption and provide high volumetric efficiency. Large, stream-lined air passages make air flow resistance negligible. CP Multi-Step Control handles partial load demands economically. CP Intercooler assures maximum heat transfer with low water consumption. CP Automatic Starting Unloader completely unloads compressor when starting and stopping.

The CP heavy-duty, conservatively rated Class O-CE Compressor is of the horizontal, double-acting, water-cooled type, with direct-mounted synchronous motor drive; in sizes up to 1,750 h.p., for pressures up to 5,000 pounds.

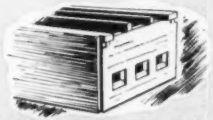
Write for full information.

CHICAGO PNEUMATIC TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

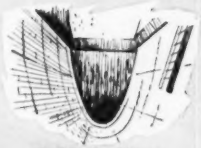
ELECTRIC TOOLS • PNEUMATIC TOOLS • AIR COMPRESSORS • ROCK DRILLS
DIESEL ENGINES • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

WHERE TO USE LUMNITE IN POWER PLANTS

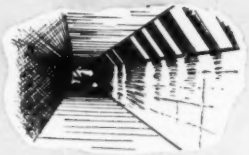
Steel Stack Linings



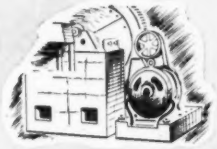
Ash Pit and Cinder Catcher Linings



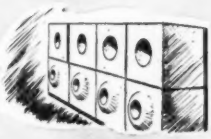
Coal Bunker Linings



Flue and Duct Linings



Overnight Structural Concrete

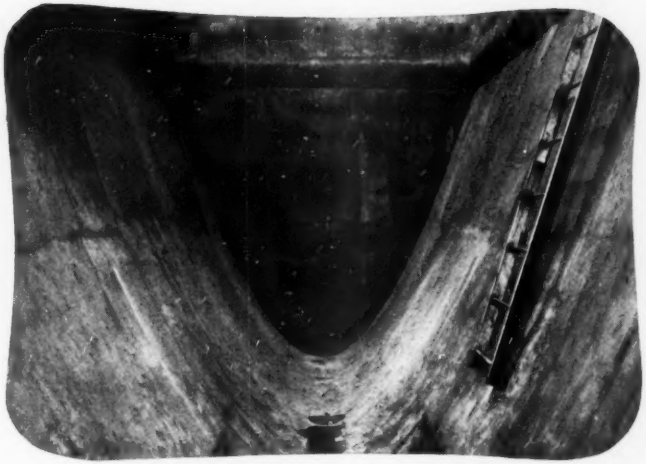


Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.

COAL BUNKERS SAFE FROM CORROSION

with tough "LUMNITE" linings



YOU minimize corrosion and abrasion when you line your coal bunkers with concrete made with LUMNITE calcium-aluminate cement.

In lining bunkers, *"LUMNITE" cement protects against the corrosive action of sulphurous water leached from coal. Applied with a cement gun, dense LUMNITE-based concrete prevents corrosive water from working in between the lining and the steel.

Tougher, smoother surfaces result from the monolithic, one-piece construction of LUMNITE. Absence of joints means less wear on linings subject to abrasion from the coal. Maintenance costs are reduced. And, because LUMNITE-based concrete reaches service strength in 24 hours or less, outage time is kept to a minimum.

For coal bunkers, resistance to abrasion and corrosion is the outstanding feature. In other power plant applications . . . flues, chimneys, ash pits . . . LUMNITE linings provide high structural strength *plus* high heat resistance and low thermal conductivity. Send for further information.

**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

Specify castables made with LUMNITE

P-L-8

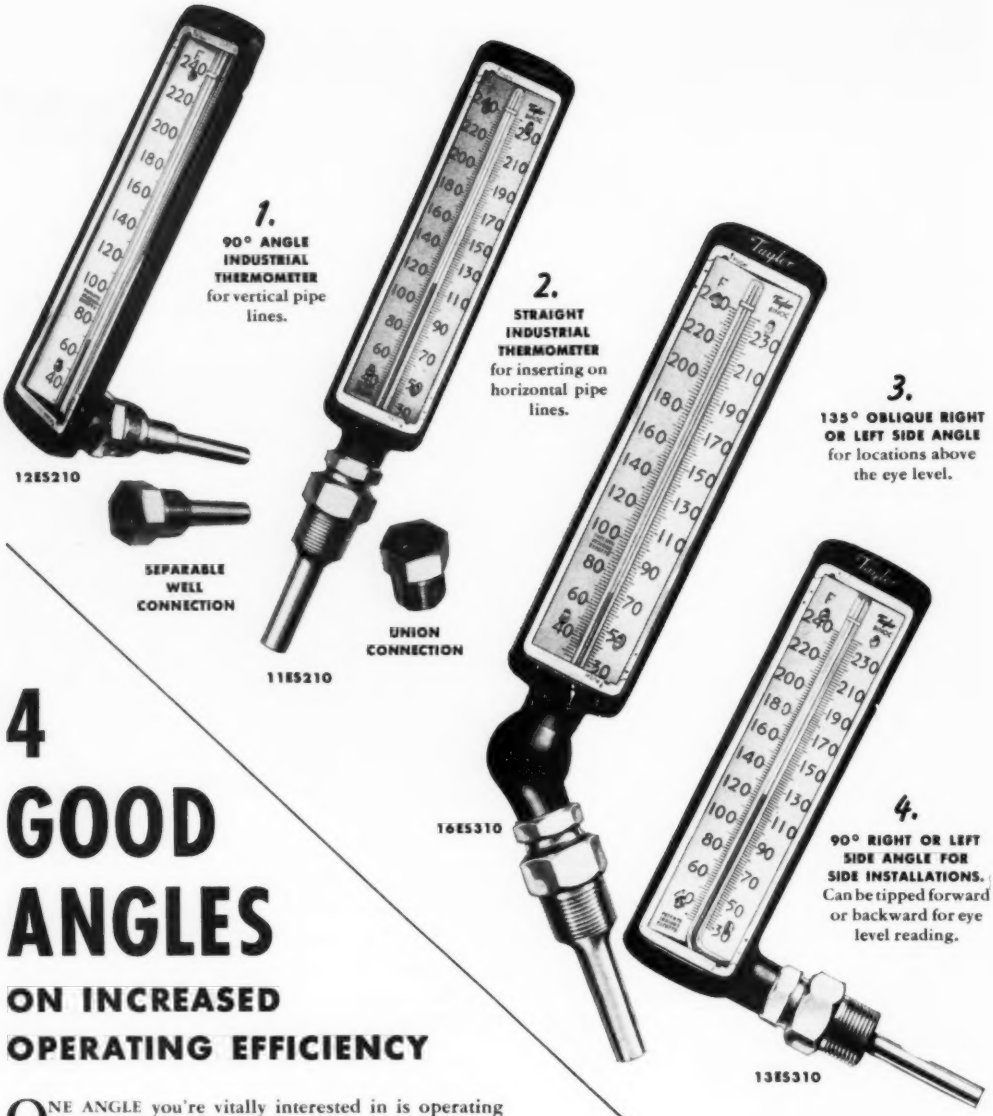
Lumnite Division

UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL CORPORATION SUBSIDIARY

135 EAST 42nd STREET • NEW YORK 17, N. Y.

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—ABC Network*

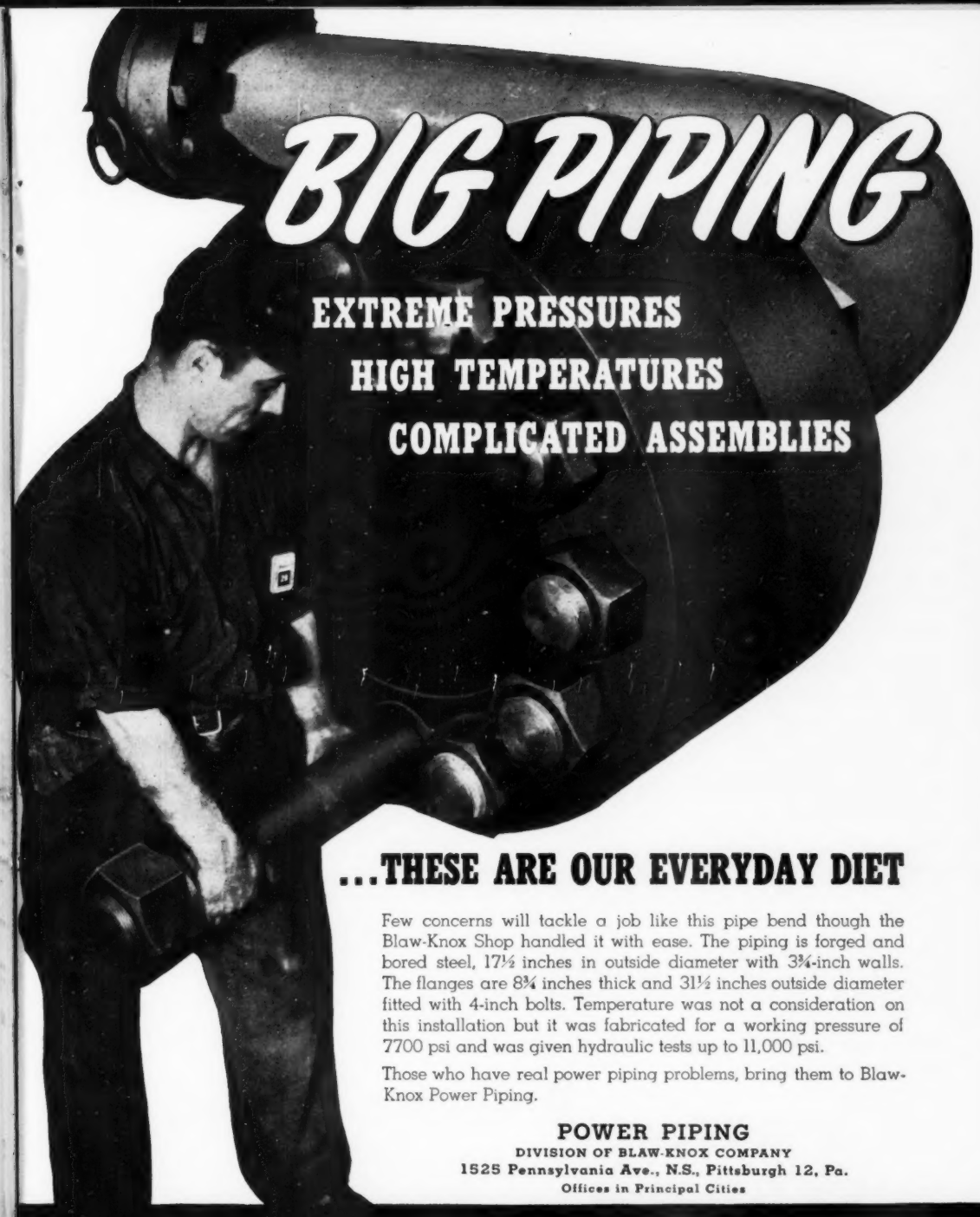


4 GOOD ANGLES

ON INCREASED OPERATING EFFICIENCY

ONE ANGLE you're vitally interested in is operating your power plant at top efficiency. And these typical Taylor Industrial Thermometers are built to give fast, accurate, dependable indications of all temperatures within minus 40 to plus 950°F, or equivalent Centigrade. They dependably verify the accuracy of other mechanical thermometers. What's more, they have the exclusive 3-times-easier-to-read BINOC tube that *actually invites* frequent reading, along with extra-bold black numerals and graduations against a white background. The thermometers shown are only a few of a wide variety of Taylor Industrial Thermometers—ready to give you long-lasting, satisfactory service. For full details write for Catalog E today! Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.*

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY



BIG PIPING

EXTREME PRESSURES
HIGH TEMPERATURES
COMPLICATED ASSEMBLIES

...THESE ARE OUR EVERYDAY DIET

Few concerns will tackle a job like this pipe bend though the Blaw-Knox Shop handled it with ease. The piping is forged and bored steel, 17½ inches in outside diameter with 3¾-inch walls. The flanges are 8¾ inches thick and 31½ inches outside diameter fitted with 4-inch bolts. Temperature was not a consideration on this installation but it was fabricated for a working pressure of 7700 psi and was given hydraulic tests up to 11,000 psi.

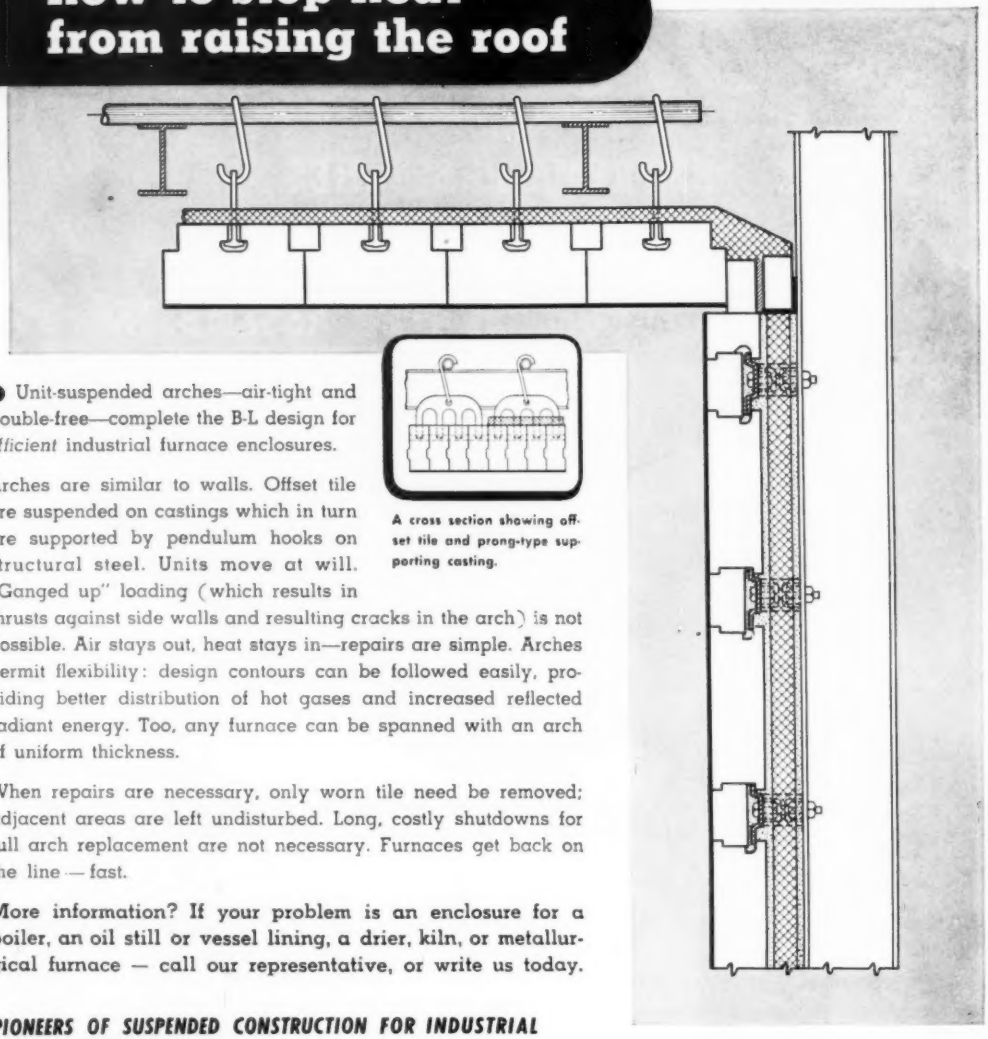
Those who have real power piping problems, bring them to Blaw-Knox Power Piping.

POWER PIPING
DIVISION OF BLAW-KNOX COMPANY
1525 Pennsylvania Ave., N.S., Pittsburgh 12, Pa.
Offices in Principal Cities

BLAW-KNOX POWER PIPING

how to stop heat from raising the roof

Arches can be insulated as shown here or air cooled. Note the corner joint and the pendulum-hook supports.



A cross section showing offset tile and prong-type supporting casting.

● Unit-suspended arches—air-tight and trouble-free—complete the B-L design for *efficient* industrial furnace enclosures.

Arches are similar to walls. Offset tile are suspended on castings which in turn are supported by pendulum hooks on structural steel. Units move at will. "Ganged up" loading (which results in thrusts against side walls and resulting cracks in the arch) is not possible. Air stays out, heat stays in—repairs are simple. Arches permit flexibility: design contours can be followed easily, providing better distribution of hot gases and increased reflected radiant energy. Too, any furnace can be spanned with an arch of uniform thickness.

When repairs are necessary, only worn tile need be removed; adjacent areas are left undisturbed. Long, costly shutdowns for full arch replacement are not necessary. Furnaces get back on the line — fast.

More information? If your problem is an enclosure for a boiler, an oil still or vessel lining, a drier, kiln, or metallurgical furnace — call our representative, or write us today.

PIONEERS OF SUSPENDED CONSTRUCTION FOR INDUSTRIAL FURNACE ENCLOSURES . . .

BIGELOW-LIPTAK

Unit-Suspended Walls & Arches

BIGELOW LIPTAK Corporation

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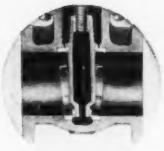

Straight-Flow Port Design reduces fluid turbulence to a practical minimum.

Seat Rings of end-seated type are screwed into the body.

Sure-Grip Malleable Handwheel for non-skid gripping even with heavy gloves.

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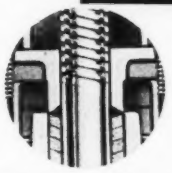
iron body gate valves

with screwed or flanged ends

... 8 Outstanding Features

For complete information on these new Walworth Iron Body Valves, see your local Walworth distributor, or write for bulletin 106.



Brass Liner on Glands assures greater resistance to corrosion and scoring.

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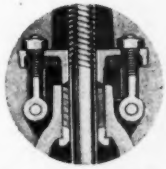
T-head Disc-to-Stem connection on OS&Y types provides stronger connection, prevents loosening of disc by corrosion.

Bronze Back-Seat Bushings in bonnets of OS&Y valves.

Solid Web Type Disc in OS&Y valves for greater strength and longer service.



Hinged Gland Eye-Bolts on OS&Y valves permit faster, easier repacking under full pressure.

The right tubes for the long pull!

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(*a patented alloy*)

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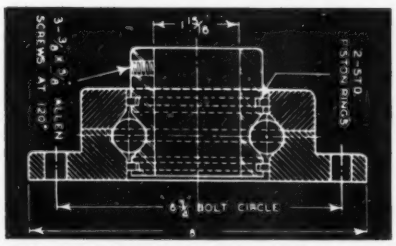
DETAILS LIKE THIS MAKE HEACON A BETTER DAMPER . . .

Heacon dust-proof bearings

. . . sealed, free turning bearings, for applications operating in dust filled atmosphere



This drawing shows the simple construction of the Heacon bearing. Ample clearance is provided to accommodate expansion due to heat and misalignment. Metal ring seals on either side of ball races provide proven guard against dust leakage, yet permit free rotation.

One of the advantages of Heacon Dampers is that of low power, constant torque for operating the curtain shaft.

Heacon designed dust-proof bearings are largely responsible for the easy rotation of this spindle—they will also operate freely even if shaft is out of alignment. The inherent design of the damper relieves the operating shaft of strain due to gas flow or static pressure.

This dust-proof bearing is only one of many details in the design of a Heacon Damper that assures you satisfactory performance with a minimum maintenance for practically the lifetime of your equipment.

Heacon dust-proof bearings are available for other applications involving shaft operation in a dust concentrated atmosphere. For information write the project engineer nearest you.

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Iron Fireman Pneumatic Spreader stoker in boiler plant of Kiewel Brewery, St. Boniface, Manitoba. Steam size coal is metered from main coal bunker and transferred by pneumatic conveyor to furnace. A conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing cinder carry-over and greatly improving combustion efficiency and responsiveness, as compared with stokers which do not preheat coal.

Manitoba brewery boosts steam production—*no increase in fuel bills*

Immediately upon the installation of an Iron Fireman Pneumatic Spreader stoker, the Kiewel Brewery of St. Boniface, Manitoba, was able to add new processing equipment with no increase in fuel costs. During the first year of Iron Fireman operation, brewery production was built up to an additional 15 brews a month, and an increased bottle washing load of 20,000 bottles a month was accomplished. "We are particularly impressed by the ease of operation and flexibility," says Peter Kraus, Chief Operating Engineer, "our Iron Fireman has followed the load, despite extreme variations, to our entire satisfaction."

Here's why Iron Fireman saves you money

There's no manual coal handling. Iron Fireman preheats the coal for quick, complete burning and pneumatically conveys it to the furnace. An adjustable nozzle spreads the coal evenly over special grates, in a shallow layer. Exclusive Air Volumeter maintains correct fuel-air ratio for highest efficiency. You get steady steam pressure, reduced cinder carryover, lower coal consumption.

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Can you afford to waste what Iron Fireman users are saving? An Iron Fireman technical man will be glad to make a survey of your present steam plant operation, without cost or obligation to you. You can thus determine in advance approximately how much an Iron Fireman installation will save for you, and what other benefits it will bring. Write for free literature. Iron Fireman Mfg. Company, 3118 West 106th Street, Cleveland, Ohio. Other plants in Portland, Oregon; Toronto, Ontario. Dealers everywhere.

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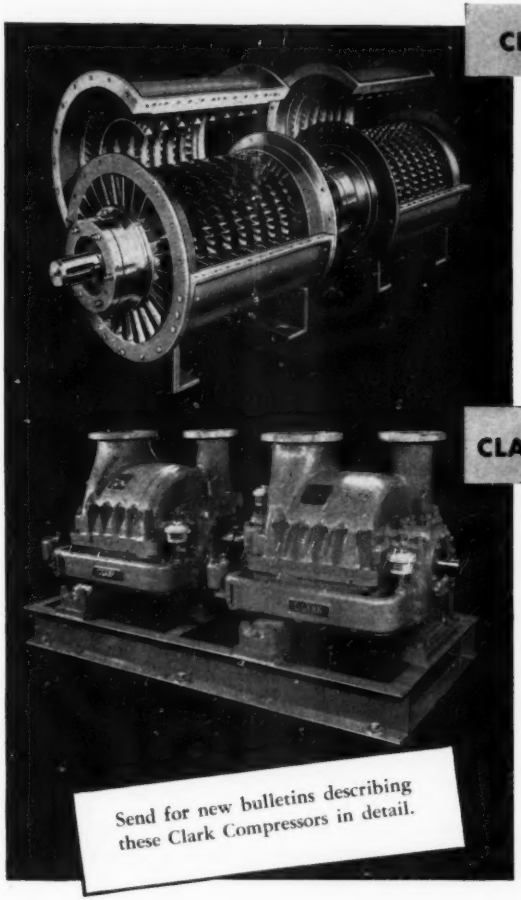

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These compact, lightweight units are suitable for electric motor, steam turbine or gas turbine drive. Clark gas turbine drives, reflecting latest developments in research and design, are built on order to customer specifications.

CLARK *Centrifugal* AIR COMPRESSOR

● Shown here are two Clark No. 2 Centrifugal Air Compressors in series, which deliver approximately 6000 CFM of free air at 110 psig pressure. Both cases of five (5) impellers each are coupled for direct drive by one 1450 HP steam turbine operating at 9400 RPM.

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Clark Bros. offer a complete line of standard, high capacity centrifugals for air or gas for volumes up to 120,000 CFM and pressures up to 900 psig. A number of Clark Centrifugal Air Compressors for 100 psig duty have been built with power requirements from 1400 to 22,000 BHP. Also several sizes have been built for the compression of hydro-carbons, oxygen and sulphur dioxide for pressures up to 450 psig.

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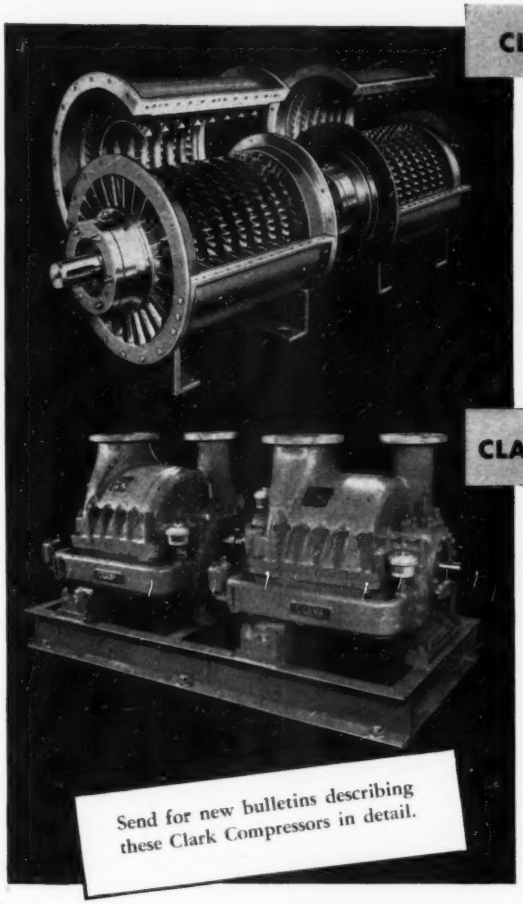

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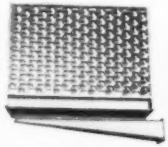
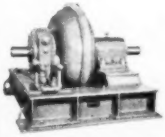


ST Fly Ash Precipitators—especially for power plants burning pulverized fuel.



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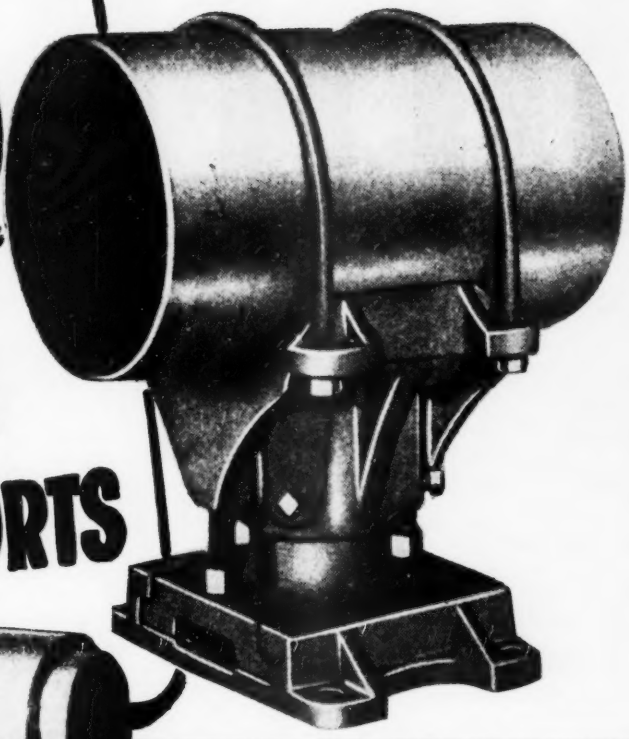

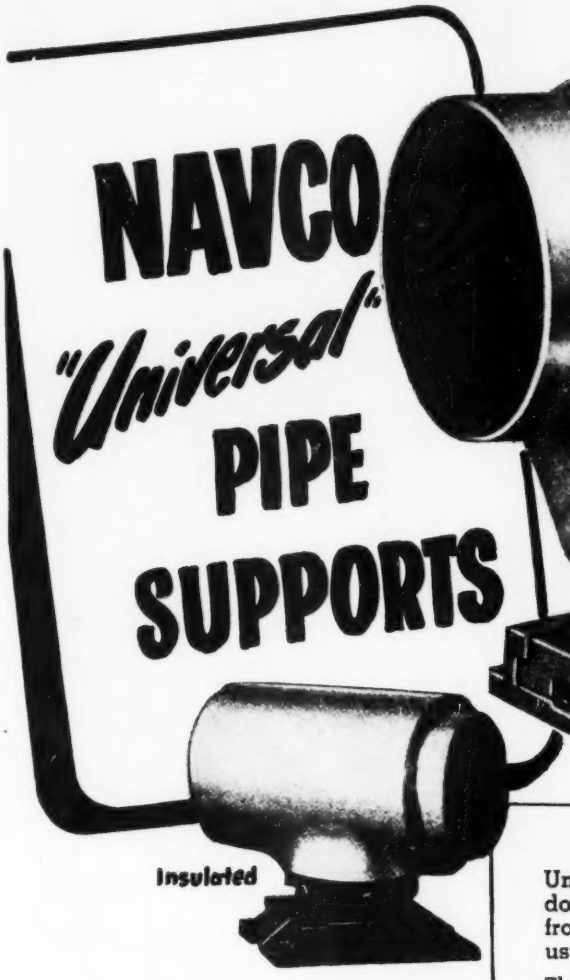

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Support may be turned to any angle of 360°.

Will take care of 8 inches of travel.

Features

Universal Pipe Supports hold the pipe down as well as up. They prevent pipe from getting out of alignment, which is usual when Roller Supports are used.

They permit control of expansion movement and insure the desired free action of Slip Expansion Joints so essential in tunnel and duct work.

Expansion movement of pipe will not disturb the insulation.

Made in Cast Iron or Steel and provided with forced lubrication for lines exposed to the weather.

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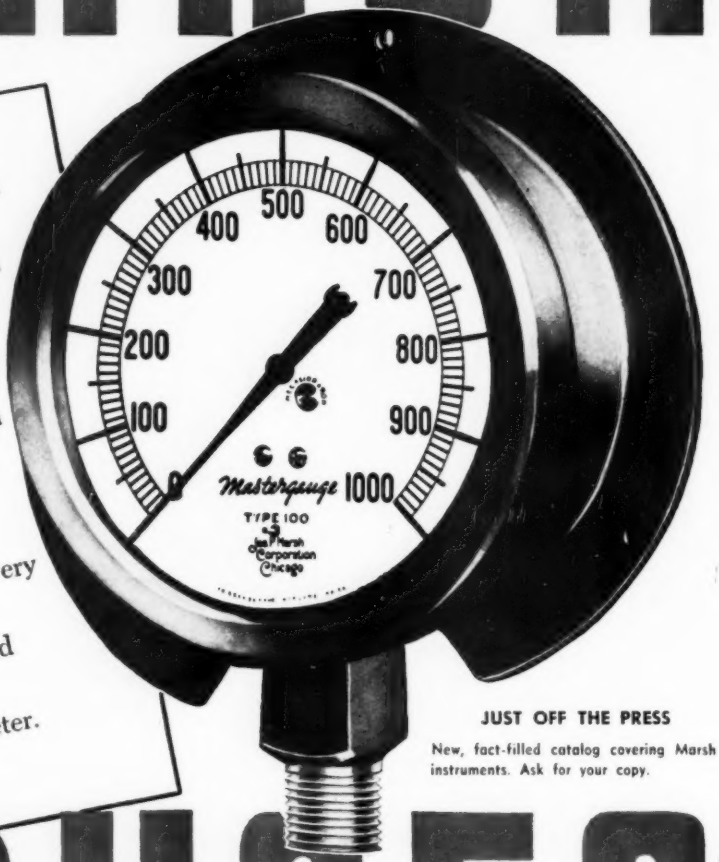

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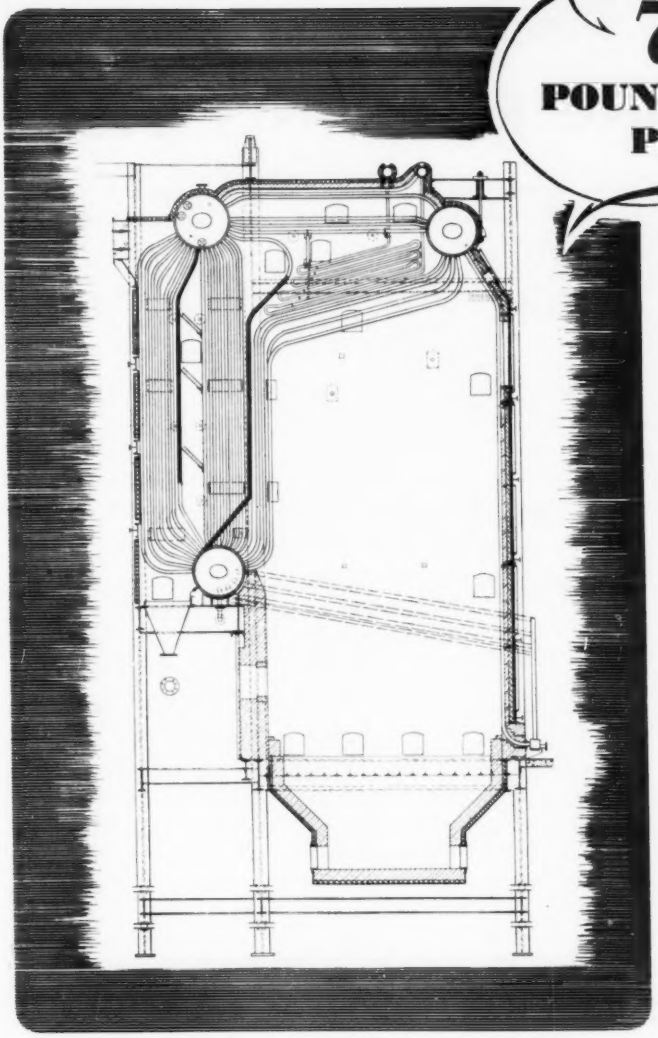

Number of Erie City Steam Generators.....1

Pounds of Steam/Hr...75,000

Design Pressure.....450 lbs.

Operating Pressure...400 lbs.

Steam Temperature..650° F.

Heating Surface—
Erie City Boiler
13,000 Sq. Ft.
Erie City Water Walls
880 Sq. Ft.

Final Exit Gas Temp..608° F.

Method of Firing
Blast Furnace Gas

Installed 1948

STEAM POWER PLANT EQUIPMENT

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizer • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

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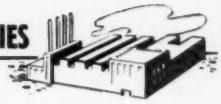

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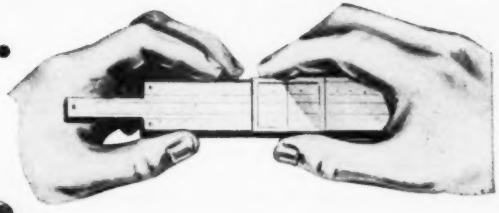

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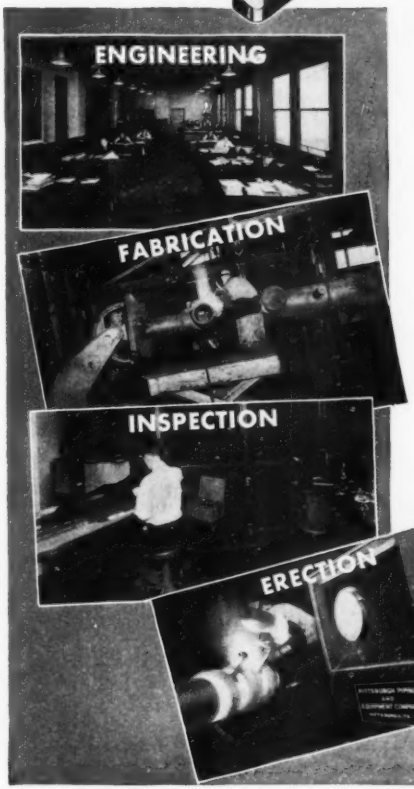

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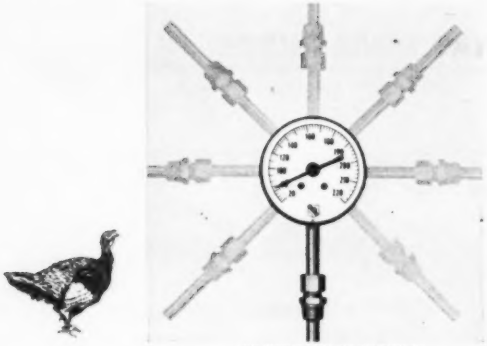

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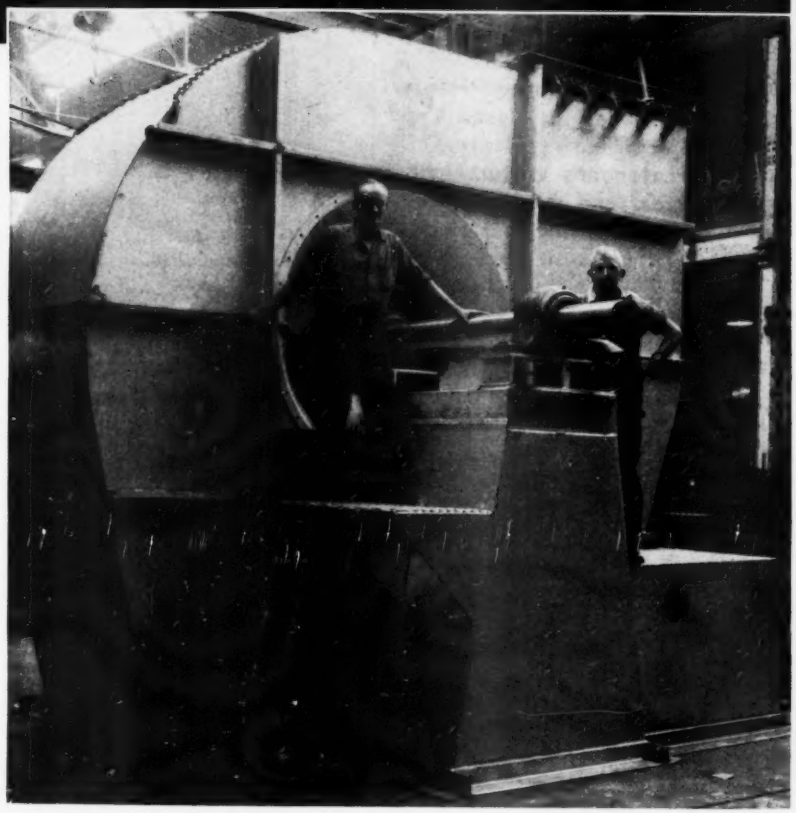

ONE OF THE LARGEST EXHAUST FANS EVER BUILT — 14 feet high, 14½ feet wide, 11 feet deep — weight, 16,250 pounds . . . two of these fans sold by Clarage Chicago office late last year to operate as essential parts of the equipment required to dry freshly mined coal.

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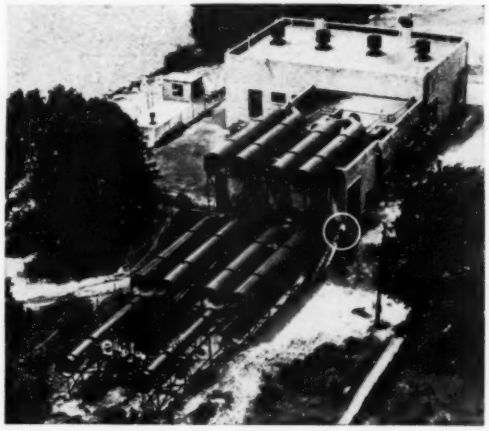

The big Maxim Silencers above (note size of man in circle) quiet the scream of centrifugal compressors on test stands . . . as tough a silencing job as you are likely to find. Maxim engineering solved it and can solve your silencing problems too. Take advantage of Maxim's greater experience when you have silencing to do.

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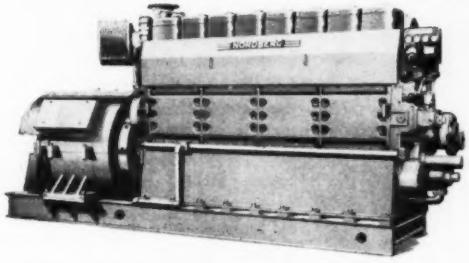

Shown in the large view above is the seven-cylinder Nordberg two-cycle Diesel which drives a 1000 K.W. generator—at an altitude of 8250 feet—for the city of Cochabamba, Bolivia. The smaller view directly above shows a typical Nordberg four-cycle stationary Diesel unit. Engines of this type are built in sizes from 175 to 1900 H.P.

WHEN you are specifying an engine for those out-of-the-way locations, the one thing you are interested in more than anything else is dependability. You want an engine that will keep running.

Nordberg engines in service all over the world have established enviable records for reliable operation. One such installation is in the power plant of the Luz Y Fuerza Electricia located in the heart of the Andes, generating light and power for the city of Cochabamba, Bolivia.

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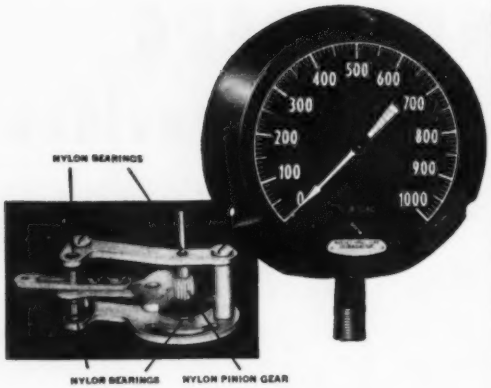

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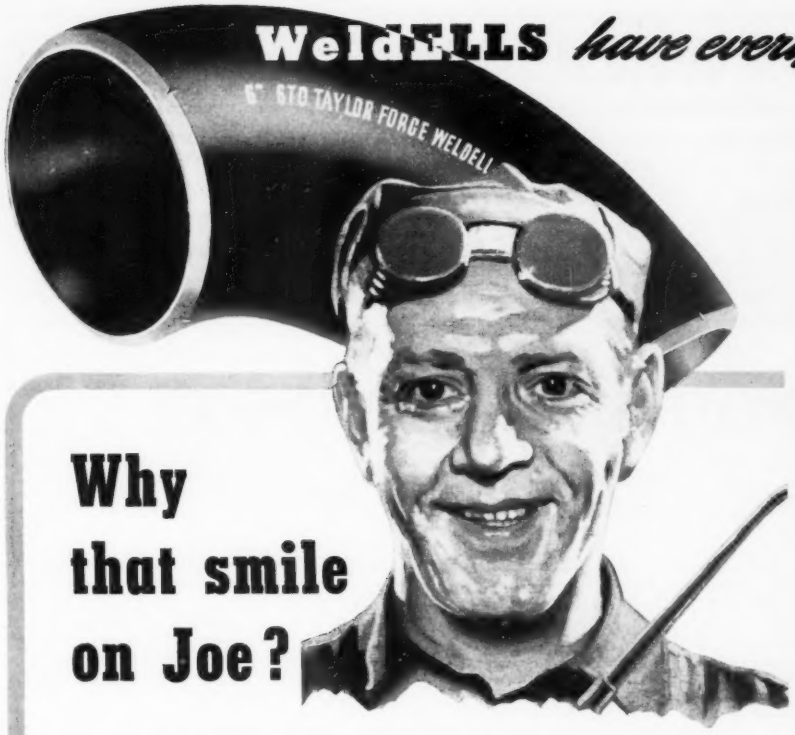

Why that smile on Joe?

Joe may not know much about the engineered strength of WeldELLS, or the metallurgical control, or the greater scope of the WeldELL line. However, it is plain enough that these considerations which mean so much to you begin to lose meaning unless Joe does *his* part of the job right.

That's why we designed WeldELLS, not only for you, but also for Joe. That's why Joe smiles: A good Welder like Joe takes extra pride in the kind of job he can turn out when it's made easy for him by these easily identified fittings, with sized end tangents, cleanly machined bevels, precision quarter markings to speed lining up, accurate key dimensions, plus other conveniences that are combined only in WeldELLS.

Yes, Joe does a better job with WeldELLS . . . and in the final analysis, *your* work rests on Joe's work!

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MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Cracking of Condenser Tubes Influenced by Excessive Vibration

Sometimes examination of leaking condenser tubes shows that they have failed from transverse cracks close to the tube sheet or midway between tube supports. Closer examination frequently reveals the presence of abrasion marks on the outside of the tubes, about midway between tube supports. Sometimes deep abrasion marks will be found in that section of the tube in contact with the support sheet. Those tubes which face the steam lane may show some roughening of their outside surface. Examination of the interior of the tube reveals, after removal of corrosion products, a few, up to several hundred, fine transverse cracks which have not perforated the tube. Deep, hemispherical corrosion pits may also be found in the affected area.

Microscopic examination discloses that the cracks have the appearance of a brittle fracture, showing very little reduction of cross-sectional area. If corrosion is not far advanced, the fracture may be very bright and coarsely crystalline. Careful laboratory examination of such tubes and study of operating data have shown that these are the symptoms of cracking resulting from excessive vibration of the condenser tubes.

Effect of Corrosion and Vibration

It has been established that when a tube is repeatedly flexed back and forth with sufficient severity for a long period of time, it will fail from fatigue cracking. The combined action of corrosion and vibration leads to more rapid development of cracks in condenser tubes. The effect of corrosion in accelerating fatigue cracking of tubing is apparently due to roughening of the surface. A roughened surface is often more subject to lowered fatigue life than a smooth surface. The flexing back and forth of vibrating tubes presumably injures the protective film and, at the points where this occurs, cracking develops. It has been observed that deep, hemispherically-shaped corrosion pits also develop in this area to a greater extent than elsewhere on the tube surface. For example, at the points of least vibration, this type of pitting is scarcely discernable.

Corrosion fatigue cracking is generally confined only to a relatively small number of tubes in a condenser or heat exchanger, because only a few tubes in the unit may be responsive to the type of vibration present.

Corrosion fatigue cracking is most prevalent where corrosive waters are encountered such as in power plants using harbor waters polluted by various types of wastes. In plants using clean, fresh water relatively little trouble from corrosion-fatigue has been called to our attention.

Sources of Vibration

Pulsating steam leaving the turbine and striking the tubes at hurricane velocities frequently starts tubes vibrating. Sometimes vibration of the turbine itself may start some of the tubes vibrating. The pumps supplying water to the condenser may also be a contributing factor. Where the pulsation of the steam or cooling water is the same as the resonant frequency of the tubes, the extent of vibration developed in the tubes is surprisingly great and is the primary cause of this type of failure.

Preventing Excessive Vibration

Condenser designers have come a long way toward keeping this type of difficulty to a minimum. In some old installations, excessive vibration has been greatly reduced by using more tube support sheets. Where that may not be practical, good results have been obtained by wedging pieces of wood or flattened tubing between the rows of tubes affected. In other cases, vibration has been reduced by making sure that all equipment is running smoothly, and by avoiding critical operating speeds of turbines, pumps, and motors.

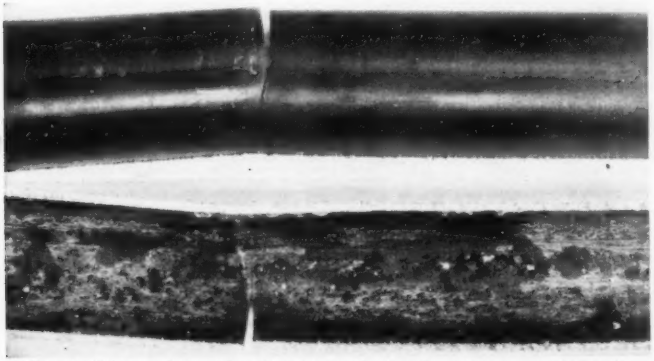
Choosing The Best Alloy

In addition to eliminating excessive vibration, it is, of course, desirable to use one of the more corrosion-resistant condenser tube alloys, such as Aluminum Brass, Cupro Nickel or Duronze IV* (Arsenical Aluminum Bronze), depending upon the conditions involved. Bridgeport's Laboratory will be glad to furnish sample lots of tubing to try out under actual operating conditions.

Proper Samples Are Important

An examination of tubing which has failed in service is often helpful in determining the cause of the trouble. However, such tubes should be submitted in suitable form and properly marked. For example, at least two full length tubes should be furnished and clearly marked as to top, bottom, inlet and outlet ends. If tubing is cut for convenient mailing, two-foot lengths are preferred, with each length numbered consecutively from the inlet to the outlet end. It is desirable to have at least one tube from that part of the unit giving the most trouble as well as that part giving the least trouble.

Contact the nearest Bridgeport office for service, and write for the 120-page Condenser Tube Manual, containing many helpful facts concerning condenser tube applications in various industries, as well as data on condenser tube alloys, corrosion, methods of installing, specifications and other useful facts. *Reg. U. S. Pat. Off. 2093380



Corrosion fatigue crack viewed from the outside and inside surfaces of the same condenser tube.

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GRADUATE ELECTRICAL and mechanical engineer. Twenty years of experience in installation and management of Diesel-electric power plants, substations and industrial maintenance. Would accept permanent position as power plant superintendent or maintenance engineer. Will furnish best references and resume of experience to interested corporations. PW-7837, Power.

SENIOR ENGINEER, 15 years experience design steam power plants. Now employed prominent consulting engineers N. Y. Desires executive position Metropolitan area or West Coast. PW-8221, Power.

GRADUATE TECHNICAL College (Amsterdam), age 34, first papers U.S.A. citizen, highest Marine, Power qualifications. 14 years experience organized maintenance, operation large Diesel, Steam, Refrigerating installations. Familiar boilerwater conditioning. Speak fluent American; knowledge French, German. Desires position Service Engineer, Plant Engineer or equivalent. U.S.A. or abroad. PW-8140, Power.

ENGINEER P.E. Wide experience design of Public Utility and industrial power plants, both mechanical and electrical. Heat balance, piping, coal and ash handling, power and light distribution. Calculations, specifications, requisitions and supervision. PW-8054, Power.

(Continued on the opposite page)

SEARCHLIGHT SECTION

(Continued from opposite page)

SELLING OPPORTUNITIES WANTED

CENTRIFUGAL PUMP Sales Agency wanted, commission basis only, intensive Eastern territory desired. SA-7825, Power.

CORNELL GRADUATE Engineer desires engineering products to sell in Indiana territory on straight commission basis. RA-8153, Power.

SELLING OPPORTUNITY WANTED

I am a special representative for Dampney and Apexior in N.Y.C. I can handle one more good line. W. T. Quimby, 142 E. 71 St., N.Y.C.

MANUFACTURERS REPRESENTATIVES
LONG ESTABLISHED AS SUCCESSFUL SALES ENGINEERING OFFICE

covering the New York Metropolitan territory for steam & power plant equipment and electrical specialties offer to represent one additional line on an exclusive commission basis. Please, mail catalogs with replies to

RA-8262, POWER
330 West 42nd Street, New York 18, N. Y.

YOUR BOILER Installed By Us

Will give you higher efficiency, longer, better service. Complete handling and installation facilities for all type boilers and accessories. Our schedule open for starting first quarter 1949 jobs only.

New—used—rebuilt boilers available
Installations made anywhere

Phone - write - wire

INDUSTRIAL EQUIPMENT CO.
Orlando, Florida

WANTED

One set of the Transactions of the Second World Power Conference, Berlin, 1930. Address replies quoting price to:

ALUMINUM SECRETARIAT LIMITED
c/o LIBRARY, Box 6090, Montreal, Quebec

WANTED

Water softening and demineralizing equipment metal-clad switch gear, 19000/2300V power transformers.

ROOM 4200, 141 WEST JACKSON BLVD.
CHICAGO, ILL.

WANTED TO PURCHASE:

2—600 HP Babcock & Wilcox long drum type, straight tube boilers equipped with forged steel headers, good for operating at 160-175 lbs. W.P. *Write or wire*

WALTER J. FOLSE, *Engineers*
1227 Hibernia Bank Bldg., New Orleans, La.

WANTED

Two pumps either horizontal double suction or vertical turbine having capacity 5,000 to 10,000 gpm at 75 THD.

RM. 4200, 141 WEST JACKSON BLVD.
CHICAGO, ILL.

WANTED

HYDRO TURBINE GENERATOR SETS
(Vertical)

150-250-350-500 or 1000 KW. Cap.
Smaller sizes 9 to 20 ft. Heads
Larger sizes 40 to 60 ft. Heads

ANDREW S. FORMAN CO.
1440 St. Catherine St. W., Montreal, Canada

2—253 HP B&W Sterling Type Boilers, 225 lbs, 100° Super Heat
2—300 KW 250 Volt. DC Turbo Generator Sets, Westinghouse. Non-condensing
1—300 KW 3 Ph-60-2300 Volt. Turbo Generator Set. Non-condensing
All Equipment 1932.

We Are Specialists in Power Plant Engineering and Installation Work

WARNER J. SHERB, INC.

342 Madison Ave. *Murray Hill 2-9098* **N. Y. 17, N. Y.**

FOR SALE
BROS Watertube Boilers

1—25,000 **1—15,000**
for
SPREADER STOKER
or
OIL FIRING

Antomatic Combustion Eqpt. Co., Inc.
P.O. Box 1478, Rochester, New York

POWER PLANT

FOR SALE — STILL INSTALLED
3—150 HP—150 lbs pressure boilers
1—500 HP Steam Engine with all accessories
FOR SALE — STILL INSTALLED
FS-7473, POWER
330 West 42 St., New York 18, N. Y.

FOR SALE

Murray-Corliss steam engine 150 hp, fly wheel 11 feet by 22 inches.

GEO. GRAYSON & SONS CO., INC.
Darby, Pa.

Air Compressors Wanted

Horizontal Water Cooled—Any size
also 2 Stage portable units

L. W. BAUER
North Bergen, N. J.

BOILER

1—460 H.P. Lasker-Adams water tube boiler Type—Class P-20—4 drum. Tubes—440—3¼" No. 10 gauge. Working Pressure—250 lbs./per sq. in. ga. Built-in Superheater 100° F.—Total Temperature 550° F. Diamond Sootblowers. Boiler equipped with Illinois Chain Grate Stoker.

Available now. On foundation plant site basis.

JOHN L. SCOTT
Purchasing Agent
Village of Winnetka, Illinois

500 KVA TRANSFORMERS

3—Transformers, 500 KVA, 1 phase, 60 cycles, substractive polarity, 2300 H. T. volts, 460 volts L. T., Type ODSC, Gals. oil 407, Spec. 9649B, Temperature rise 55 c, Impedance at 75 degree C 4.1%, Serial #714538, 39, 40, Allis-Chalmers Mfg. Co., Pittsburgh Transformer works, Pittsburgh, Pa., USA.

Excellent Condition.

FS-8302, POWER
330 W. 42nd St., New York 18, N. Y.

WANT TO BUY *NEW SURPLUS*
VALVES & PIPE FITTINGS

EAST COAST VALVE & FITTING CO., INC.
725 FIFTH AVENUE **BROOKLYN 32, N. Y.**

WANTED

Steam Engine Set 500-600 KW Capacity 440 Volt, 60 cycle, 3 phase, Uniflow-Vertical Type Preferred 125-150# Pressure.

LOUISVILLE COOPERAGE CO.
421 W. Avery St., Louisville, Kentucky

WANTED
SURPLUS PIPE FITTINGS
ANY TYPE OR QUANTITY

PRUDENTIAL PLUMBING PRODUCTS CORP.
261 E. 134 St., New York 54, N. Y.

BOILERS WANTED
Any Condition - Anywhere

USABLE OR OBSOLETE STEAM & ELECTRICAL MACHINERY PURCHASED, DISMANTLED & REMOVED.

Men-Tools-Insurance - 30 Yrs. Experience

G. M. LINDER
40-18 216 Street
Bayside, L. I., N. Y.
Tel. BAyside 9-2121

"We Can Dismantle Anything Made of Metal"

DIESEL POWER PLANTS

OFFERED FOR QUICK DELIVERY

FROM

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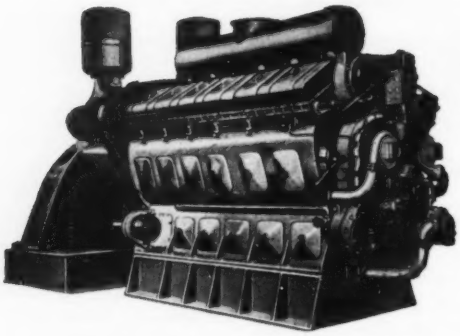
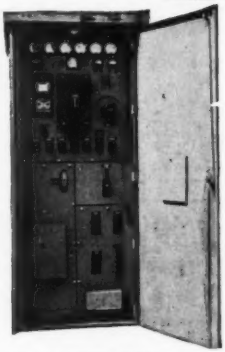




1080 BHP GENERAL MOTORS DIESEL ENGINE MODEL 12-567 WITH DIRECT CONNECTED G. E. ALTERNATOR RATED 900 KVA, 3 PHASE, 60 CYCLE, 2400 VOLTS.

• 50 AND 60 CYCLE OFFERINGS •

ALTERNATING CURRENT DIESEL GENERATORS

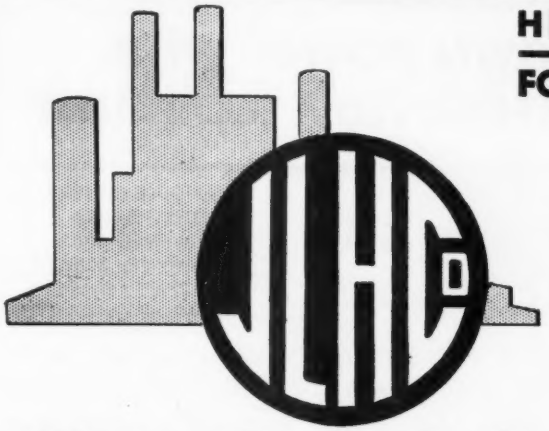
KVA	Make	Model	HP	RPM
1420	Fairbanks-Morse	38D8⅛	1600	720
1250	General Motors	16-278A	1600	720
1250	Nelseco	6M1-53	1500	300
1000	General Motors	12-278A	1200	720
900	General Motors	12-567	1080	720
800	Alco	6-12½ x 13T	975	720
625	Baldwin	VO-8	750	514
625	Superior	OS	750	327
425	Baldwin	VO-6	510	450
400	Buckeye	80	480	600
375	Enterprise	DSG-6	450	450
312	General Motors	8-268A	450	1200
250	General Motors	8-268A	350	1200
200	Buckeye	80	240	600
125	Superior	GDB-8	150	1200
125	General Motors	3-268A	150	1200
125	Murphy	ME-605	150	1200
121	Fairbanks-Morse	32E14	140	300
75	General Motors	6043E	90	1200
75	Fairbanks-Morse	35E8¾	90	450
62	Int'l Harvester	UD-18	76	1200
50	General Motors	4-71	60	1200
18	Int'l Harvester	UD-6	22	1200

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc. ESTABLISHED 1898

Diesel Engines • Power Machinery

52 CHURCH STREET, NEW YORK 7, N. Y. PHONE Digby 9-4350



HERE IS PROTECTION FOR YOUR PRODUCTION

THE HEMPHILL SEAL
GUARANTEES
YOU'RE GETTING
RELIABLE EQUIPMENT

REBUILT — THEN TESTED BY ELECTRICAL ENGINEERS

TRANSFORMERS

1—1000 KVA G.E., 3 Ph. auto 4150V.—2300V.
1—667 KVA, G.E., 3 phase, Auto, 4150 V.—2300 V.
1—500 KVA Kuhlman 4150 volt primary 2300 volt Sec.
3—300 KVA, Pitts., 2300 V. Pri., 115/230 V. Sec.
3—300 KVA, G.E., type H, 2300 V Pri., 115/230 V Sec.
300 KVA, Pitts., 7800-440 v.
205 KVA, Whse., 2 phase, 2300 to 3 ph., 4150 autp.
200 KVA, 4000 v.—110/220.
100 KVA, Pitts., 1375/2750 v.—110/220.
3—100 KVA, Wagners, 240/120 v.—120 v.
2—100 KVA, Newark, 440 v., 3 phase to 220 v., 2 phase.
2—100 KVA, Whse., 13,800 v. to 250 v.
3— 75 KVA, G.E., 2400 v.—120/240.
6— 50 KVA, Whse., 2400 v.—120/240.
6— 50 KVA, Whse., 13,800 v. to 125 v. or 250 v.
6— 50 KVA, Whse., 6900 v. to 125 v. or 250 v.

A. C. GENERATORS

2500 KVA, Whse., Syn. Cond., 720 RPM, 2400 v.
500 KW, .8 P.F., 3600 RPM, ATB, 600 v.
320 KW, Allis, 450 RPM, 480 v.
240 KW, G.E., ATB, 600 RPM, 600 v.
200 KVA, Allis, 3600 RPM, 240 volt.
200 KVA, Whse., 600 RPM, 240 v.
180 KW, Whse., 514 RPM, 550 v.
165 KW, El. Mach., 514 RPM, 240 V.
100 KW, G.E. ATB, 600 RPM, 240 v.
75 KW, Whse., 900 RPM, 220 v.
62½ KW, Allis, 3600 RPM, 220 v.
7— 50 KVA, Whse., 900 RPM, 220 v.
3— 35 KWA, Columbia, 1200 RPM, 240 v.
1— 31.3 KVA, America, 1200 RPM, 120/208.
15 KW, Star, 1800 RPM, 220/440.
12.5 KVA, Whse., 1200 RPM, 240 v.

TURBINE BLOWERS

1—Spencer Turbine Blower, 1000 cubic feet, 30 oz. pressure with a 15 H.P., 3600 RPM, General Electric Type FT, 200 volt motor.
1—Bellmore, 550 cubic feet, 7 inch vacuum, with a 20 H.P. 3600 RPM, General Electric, Type K, 220 volt 3 phase motor.

MOTORS, 3 Phase, 60 Cycles
SQUIRREL CAGE

750 H.P., General Electric, 750 RPM, 6600 v., 25 cycle.
450 H.P., Ridgeway, 900 RPM, 2300 volts.
125 H.P., G.E., KF, 1750 RPM, 2200 v.
125—H.P., U.S., 1200 RPM, Vert., 220 volts.
100 H.P., G.E., 400 RPM, 440 volt.
75 H.P., West., CS, 1750 RPM, 440 volts.
60 H.P., Whse., 900 RPM, Vert., 2200 volts.
60 H.P., Whse., 900 RPM, 440 volts.
2— 40 H.P., G.E., 900 RPM, 220 volts.
35 H.P., Whse., 1200 RPM, CS, 2200 volts.

MOTORS, 3 Phase, 60 Cycles
SLIP RING

2500 H.P., G.E., 257 RPM, 6600 volts.
450 H.P., G.E., 425 RPM, ITC, 440 volts, 25 cycle.
2— 150 H.P., G.E., 1M, 440 volt, 450 RPM.
100 H.P., G.E., IM, 440 volt, 25 cycle, 720 RPM.
1—100 H.P. G.E. 1M, 440 V. 400 RPM
75 H.P., Whse., CW, 720 RPM, 440 volt.
75 H.P., G.E., MT, 1200 RPM, Vert.
50 H.P., G.E., MT, 600 RPM, 220 volt.
2— 50 H.P., Whse., CW, 900 RPM, 220 volts.
40 H.P., Cont., 1200 RPM, JA85, 220 volt.
40 H.P., G.E., 1200 RPM, MT, 220 volt.
40 H.P., G.E., 900 RPM, 220 Volt, ITC.
40 H.P., G.E., 900 RPM, MT, 900 RPM, 220 volt.
40 H.P., G.E., 900 RPM, 2200 volt.

DIESEL GENERATOR SETS

3—300 KW 125/250 V. De La Vergne—Baldwin 6 cyl., 4 cycle with Westinghouse generators

LARGE STOCK OF
D.C. MOTORS AND GENERATORS

SYNCHRONOUS MOTORS

4—200/100 H.P., Whse., 720/360 RPM, 4150 v.
200 H.P., Whse., 600 RPM, 240 v.
1—200 H.P., G.E., 257 RPM, 440 volt.
1—150 H.P., G.E., 1800 RPM, 220 v. TR
2—150 H.P. Allis-Chalmers 360 RPM, 2200 V.
75 H.P., G.E., 1200 RPM, 440 v.
70 H.P., Elect. Mach., 180 RPM, 2200 v.
40 H.P., Whse., 1800 RPM, 220 v.
35 H.P., G.E., 1200 RPM, 2200 v.
20 H.P., Whse., 1800 RPM, 220 v.

MOTOR GEN. SETS

1—1000 KW Westinghouse, 275 V.—4150—720 RPM Syn.
1—1000 KW, G.E., 600 volts—4150—514 rpm. Syn.
1— 400 KW., G.E., 250 V. 900 RPM, 2300 V. Syn.
1— 500 KW., G.E., 575 V. 900 RPM, 2300 V. Syn.
125 KW, CW, 125 v., 1200 RPM, 2300 v. sq. cage.
100 KW, El. Mach., 125 v., 1200 RPM, 4150 v. syn.
100 KW, G.E., 230 v., 900 RPM, 4150 v. Syn.
2— 75 KW., G.E., 125 v., 1200 RPM, 220/440 v.
6— 75 KW, G.E., 60 v., 1200 RPM, 220/440 v.
50 KW, Ridgeway, 550 v., 1200 RPM, 220 v.
25 KW G.E., ATI, 1800 RPM, 40 HP, 1800 RPM, 230 v.

PLATING M. G. SETS

250 amp. G.E., 5/6 volt, 220 v.
500 Amp., Hansen Van Winkle, 24 volt, 220/440 v.
2500 Amp., Chandeysson, 6/12 v., 400 RPM, Syn., 440 v
3000 Amp., Chandeysson, 6/12, 400 RPM, syn., 440 v.

ENGINE GEN. SETS

150 KVA, G.E., Ames Uniflow, 220 v., 3 ph., non cond.
2— 5 KW., Gasoline, Hobart, 1800 RPM, 120 v., 1 ph cont. engines.
1—200/275 H.P., Gasoline Engine, Van Blerck, 8 cylinder, 1500/900 rpm.

TURBO. GEN. SETS

625 KVA, Westinghouse, 2400 v., 3 phase, non-con.
300 KW, G.E., ATB, 240 v., 3 ph., cond.
60 KW, Whse., 120 v., D.C., cond.
30 KW, Allis, 120 v., D.C., Terry non-cond.

STEAM TURBINES

500 HP., G.E., 3 stage, 165#, 3240 RPM.
800 HP., Terry Tandem type, 720 RPM, red. gear.

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"
J.L. HEMPHILL & CO.
1604 53rd STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 3-2600

GENERATE YOUR OWN POWER WITH "UTILITIES APPROVED" EQUIPMENT

TURBINE-GENERATOR UNITS

3 Phase, 60 Cycle

6250 KVA G.E. condensing, 5 stage, 200# pressure, 600°TT, 2300 volt, 3600 RPM.

1563 KVA G. E. condensing, 300 to 400 lbs. pressure, 2300 volts, 3600 RPM complete exciter, surface condenser.

1250 KVA G. E. condensing, 250 lbs. pressure, 480/600/2300 volts, 3600 RPM complete shaft exciter, switchboard and surface condenser, panel.

1250 KVA G. E. condensing 200 lbs. pressure, 4150 volts, 3600 RPM complete exciter, condenser, panel.

1250 KVA, 480 volts, Allis-Chalmers, 150/175 lbs. pressure complete with surface condenser.

625 KVA G. E. condensing, 150-175 lbs. pressure, 480 volts, 3600 RPM complete exciter, switchboard, surface condenser.

625 KVA G. E. non-condensing, 150 lb. pressure, 15 lbs. back, 2300 volts, 3600 RPM complete exciter, panel.

375 KVA (2) G. E. condensing 400 lbs. pressure, 450 volts, each complete exciter, switchboard, surface condenser.

375 KVA G. E. condensing 125 lbs. pressure, 2300 volts, 3600 RPM complete surface condenser and panel.

250 KVA Allis-Moore non-condensing 200# pressure, 40# gauge back, 440 volts, 3600 RPM.

125 KVA G. E. non-condensing, 175 to 200 lbs. pressure, 10 lbs. gauge back, 2300 volts, 3600 RPM complete.

112 KVA Allis non-condensing 175# pressure, 5# gauge back pressure, 240 volts.

100 KVA Westg. non-condensing, 125 to 150 lbs. pressure, 10 lbs. gauge back, 2400/600 volts, 3600 RPM.

TURBINE-GENERATOR UNITS

Direct Current

(2) 400 KW, 240 volts direct current Crocker-Wheeler—Worthington 440 lbs. pressure condensing steam turbine-generator units.

200 KW (3) New General Electric 120 volts Marine type turbine generator units.

150 KW (2) 120 volts, 250 p.s.i., 650°TT Westinghouse Worthington condensing units.

75 KW Allis Chalmers-Terry, 125 volts, 2400 RPM, 150 lbs. pressure non-condensing turbine generator unit.

60 KW (3) new Westinghouse 120 volt Marine type turbine generator units.

SYNCHRONOUS MOTORS

300 HP 80% P. F. G. E. type ATI, 2300 volts, 720 RPM synchronous motor.

900 HP Allis 3 phase, 60 cycle, 2200 volts, 150 RPM synchronous motor.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers 550/600 volts, 300 RPM direct current generator direct connected 2190 HP, 3 phase, 60 cycle 4000/6600 volts synchronous motor.

500 KW General Electric 600 volt DC, direct connected to 710 HP General Electric 3 phase, 60 cycle, 2300 volt, 720 RPM synchronous motor.

400 KW Gen. Elec. 275 volt DC, direct connected to 710 HP Gen. Elec. 3 phase, 60 cycle, 2300 volt, 720 RPM synchronous motor.

300 KW KW Allis Chalmers, 250 volt DC generator direct connected to a 430 HP Allis Chalmers 3 phase. 60 cycle, 440 volt, 1200 RPM synchronous motor.

621½ KVA G. E. 3 phase, 60 cycle, 2300 volt, 1200 RPM alternator direct connected 75 HP 125 volt DC motor.

50 KW Westg. 125 volt, 1200 RPM direct current generator direct connected 75 HP, 3 phase, 60 cycle, 2300 volt motor.

10 KW, 125 volts DC Gen. Elec. generator with 12 HP, 3 phase, 60 cycle, 220 volts, 1800 RPM motor.

DIESEL GENERATOR UNITS

Alternating Current, 3 Phase, 60 Cycle

375 KVA Fairbanks-Morse, 240 volts, 300 RPM generator direct connected to 450 HP, 300 RPM, 8 cylinder, Model 32-E-14 full Diesel engine complete with switchboard.

(6) 125 KVA Westing., 450 volt, 1200 RPM, direct connected to Gen. Motors Diesel.

DIESEL GENERATOR UNITS

Direct Current

(4) 300 KW, 120/240 volts, 3-wire, 400 RPM Westinghouse direct current generators each direct connected to a 448 BHP Baldwin Diesel engine.

250 KW Crocker-Wheeler, 250 volt, 257 RPM generator direct connected to 360 HP, 6 cylinder late type Fairbanks-Morse full Diesel engine—complete.

STEAM ENGINE-GENERATOR UNITS

Direct Current

400 KW G. E. 250 volts, 360 RPM generator direct connected to Skinner Unaflow vertical non-condensing engine, 150 lbs. pressure, 10 lbs. gauge back.

400 KW Crocker-Wheeler 250 volt, 150 RPM generator direct connected to a 24 x 32 Chuse, non-releasing Corliss engine. 150# pressure, 5# gauge back.

275 KW Westinghouse 250 volt, 350 RPM generator direct connected to Ames vertical Unaflow engine.

200 KW, G. E. 125 volt, 200 RPM generator direct connected Skinner Unaflow engine.

STEAM ENGINE-GENERATOR UNITS (Cont'd)

Direct Current

15 KW Crocker-Wheeler, 125 volts, 410 RPM generator direct connected to an American Blower vertical engine.

STEAM ENGINE-GENERATOR UNITS

Alternating Current, 3 Phase, 60 Cycle

1125 KVA G. E. 480 volts, 150 RPM generator direct connected to 28" x 36" Nordberg Unaflow engine.

500 KVA G. E. 240 volt, 360 RPM generator direct connected Skinner vertical Unaflow non-condensing engine.

500 KVA Westg. 480 volts, 164 RPM generator direct connected to 25" x 28" Skinner Unaflow non-condensing engine, 140 to 160 lbs. pressure, 0 to 10 lbs. gauge back.

312 KVA, 220 volts, Westinghouse 200 RPM generator direct connected Harrisburg-Fleming corlis engine, 125 lbs. pressure.

312 KVA G.E. 2300 volts, 360 RPM generator direct connected 12"x12", 4 cylinders Ames vertical Unaflow non-condensing engine.

156 KVA, 240 volts, 240 RPM generator direct connected to 17" x 16" Skinner Counterflow non-condensing engine 100-125# pressure.

125 KVA Westinghouse 240 volt, 257 RPM generator direct connected to Ames Unaflow engine.

DIESEL ENGINES

(10) 900 HP General Motors, Model 12-S67 ATL, 12 cylinders, 744 RPM Diesel engines complete with auxiliaries. Practically new.

ALTERNATING CURRENT GENERATORS

750 KVA Westinghouse 3 phase, 60 cycle, 460 volt, 150 RPM synchronous alternator.

560 KVA Allis 3 phase, 60 cycle, 240 volt, 360 RPM alternator.

500 KVA Westg. 3 phase, 60 cycle, 440/550 or 2300 volts, 514 RPM three bearing belted alternator.

400 KVA Allis 3 phase, 60 cycle, 480 volt, 240 RPM alternator.

312 KVA Westinghouse 3 phase, 60 cycle, 600 volt, 600 RPM alternator.

300 KVA G. E. type ATI, 2300/440 volts, 720 RPM generator.

SPECIALS

5425 GPM Worthington 70' head, 1800 RPM centrifugal pump direct connected to 125 HP G. E. 3 phase, 60 cycle, 220 volt slip ring motor.

(2) 1000 GPM, 1270 Ft. Head Morris pumps each direct connected to a 417 HP, 390# pressure G.E. non-condensing turbine.

(1) 700 GPM, 575 Ft. Head Morris Pump direct connected to 160 HP, 200# pressure G.E. non-condensing turbine.

(1) 4400 sq. ft. and (1) 1250 sq. ft. Elliott surface condensers.

10 ton Capacity Brown hand operated traveling crane with 31'10" span including 150" of I-beams.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG. CLEVELAND 14 OHIO

WIRE OR PHONE LONG DISTANCE 422

Something to remember:

OUR 41 year REPUTATION IS YOUR PROTECTION

WHEN YOU BUY RE-NU-BILT MOTORS FROM BELYEA

RE-NU-BILT EQUIPMENT

Rebuilt in accordance with N.I.S.A. Rebuilding Standards

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	WK	Make	Speed	D.C. Volts	A.C. Volts
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2200/4400
1	1250	G.E.	600	275	2300
1	1000	Westt.	514	250	4150
1	1000	Whse.	514	600	4150
2	1000	Ck. Wh.	720	250	2300/4150
1	800(30)	G.E.	1200	120/240	2300
2	500	G.E.	720	600	2300/4150
1	500	G.E.	720	125	2300/4000
1	500	G.E.	900	250	2300/4600
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	2300/4150
1	300	G.E.	1200	250	440
1	150	Cr. Wh.	1200	250	440
1	100	G.E.	1170	125	220
1	100	G.E.	1200	250	2200
1	90	G.E.	1200	60	220/440
1	75	Cr. Wh.	1160	250	220/440
1	75	G.E.	1180	125	2400/4000
6	70	G.E.	1200	70	220/440
2	50	G.E.	1145	125	220

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		4800	720
1	3000	G.E.	ATI	4800	720

ROTARY CONVERTERS

60 Cycle

KW	Make	Speed	D.C. Volts	A.C. Volts
1—2000	G.E.	514	600	13800
1—2000	G.E.	450	600	2300
1—1000	Whse.	900	600	11000
1—750	Whse.	900	600	13200
1—500	Whse.	900	250	2300

FREQUENCY CHANGER SETS

1—1000 KW—GE—2 unit—3 Brg. Consisting of—1400 HP—4400 V., 3 ph. 25 cy. Motor and 1000 KW—2300 V. 2 ph. 58.3 cycle gen. with exciter (Gen. can be reconnected for 800 KW 3 ph.)

1—320 KW—GE—2 Unit—3 Brg. consisting of 600 HP—440 V., 3 ph. 60 cy., .8 pf. Syn. Motor and 400 KVA, .8 pf, type AT—3 ph, 120 cy, 720 volt AC generator with direct connected exciter.

D. C. MOTORS

HP	Make	Type	Volts	Speed
5—1500	Whse.		525	600
1—1200	Whse.		600	425
1—800/1000	Whse.		450	600/720
1—700	G.E.	MCF	600	150/525
1—650	G.E.	MPC	250	115/145
1—300/400	G.E.	2YNA	250	1325/2500
1—335	Whse.	MQ	250	300/900
1—200/300	G.E.	MPC	230	360/920
1—275	Whse.	QM-600-6	230	425/850
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—150	G.E.	MPC	230	250/450
1—150	Cr. Wh.	CCM	230	300/1050
1—150	G.E.		600	250/750
10—150	Cr. Wh.	83H	230	890
1—150	Cr. Wh.	CMC-65H	230	1150
2—125	G.E.	CO-1832	230	625
1—125	El. Dy.	308	230	750/1500
1—115	Cr. Wh.	JHL	230	1200
3—101	Whse.	SK	230	485/950
2—100	Rel.	1050T	230	400/1200
1—90	G.E.	CDM-1242Z	115	1800
1—50/100	G.E.	CD-175	230	385/730
2—80	El. Dy.	308	230	475/1350
1—75	Whse.	SK-100L	125	650
2—75	El. Dy.	25-8L	230	750/1750
3—60/75	Whse.	SK-200	115	300/700
4—75	Cr. Wh.	53-H	230	860
2—75	G.E.	CDM-1126Y	230	2000
1—60	Whse.	SK-160	550	680
1—60	El. Dy.	25-8	230	525/1050
2—60	Whse.	Holst.	230	415
1—60	Whse.	SK	230	500/1000
1—60	Whse.	SK-131	230	500/1500
1—60	El. Dy.	258	230	750/1500
2—50	G.E.	RCP-31B	230	1700
4—50	Whse.	Holst	230	400
1—50	Whse.	SK-153	230	600/1035
1—50	Cr. Wh.	CMC-80H	230	380/750
3—40	Rel.	385 T "VS"	230	400/1500

with 40 KW MG sets, 230 v. DC, 220/440-3-60 Exciters and automatic "VS" control.

SPECIAL—MERCURY ARC RECTIFIERS

1—750 KW—GE—Type RHW—6 Anode 575 V., D.C. Form C with 2300 V., 60 cycle transformer and switching equipment.

1—1000 KW—American B.B. Type GRZ-612—12 anode 625 V.D.C. with 1040 KVA O15C—3 phase—13200/6600V-25/60 cycle transformer with full automatic switching equipment along with 2 distribution panels.

1—1000 KW—Al.Ch. type B-612—12 anode 625 V.D.C. with 1140 KVA O15C—3 phase—13500V.—60 cycle transformer with manually operated switching equipment along with voltage regulator and grid control.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
1—2100	G.E.	ATI	4600	514
2—2000	Whse.		2300	120
1—1000	Whse.		2300	1894
2—900	Al. Ch.	(New)	2200	150
1—600	Whse.	Syn.	440	360
1—500	G.E.	ATI	480	900
2—500	G.E.	TS	4150	600
1—450	Whse.	Eng.	2200	128.5
2—350	G.E.	TS	2200	150
1—320	G.E.	ATI	2300	600
1—300	G.E.	ATI	440	720
1—300	Whse.		2300	720
1—300	Al. Ch.		440	600
1—145	G.E.	ATI	550	720
2—125	G.E.	ATI	440	450
1—100	Whse.		550	600
2—100	G.E.	TS-7651	440	450
1—100	G.E.	TS	440	1800
1—100	E.M.	Unused	440	600

SLIP RING

1—1000	Whse.	CW	2300	700
2—700	Whse.	CW	2300	900
1—500	G.E.	IP	550	505
1—500	G.E.	IM-MIII	2200	450
3—450	G.E.	IM	440	506
1—400	G.E.	IM	2200	252
1—400	G.E.	IM	440	720
3—350	Whse.	CW	2200	900
1—350	G.E.	MT-442Y	2200/4000	253
1—300	Al. Ch.	3 Brg.	2300	505
1—300	G.E.	IM	440	720
1—250	G.E.	MT-424Y	4000	257
1—250	G.E.	MT-559S	2200	1750
1—135	G.E.	IM	2300	100
2—100	G.E.	IM-16	2200	435
1—75	Whse.	CW-761	2300	1257
1—75	F.M.	Bv-H16B	2300	1800
1—60	Cr. Wh.	123-AQ	220	700
1—55	Whse.	CI-838A	220	870
2—50	Whse.	CIW-504	440	870
1—50	Rel.	IXM	2300	880

SQUIRREL CAGE

1—250	G.E.	KT-559	440	1800
1—200	G.E.	IK	550	865
1—200	G.E.	KT-557	440	1800
1—150/50	Whse.	CS	440	879/343
1—125	Whse.	MS	440	485
1—125	(New) G.E.	KF-TEFC	440	1190
1—125	G.E.	KF-TEFC	440	3585
1—100	G.E.	IK	440	575
1—100	G.E.	IK-Vert.	2300	450
2—100	G.E.	KT-543	220/440	1750
1—60/20	Whse.	CS	220	900/450

Turbo Generators

See our advertisement on page 294

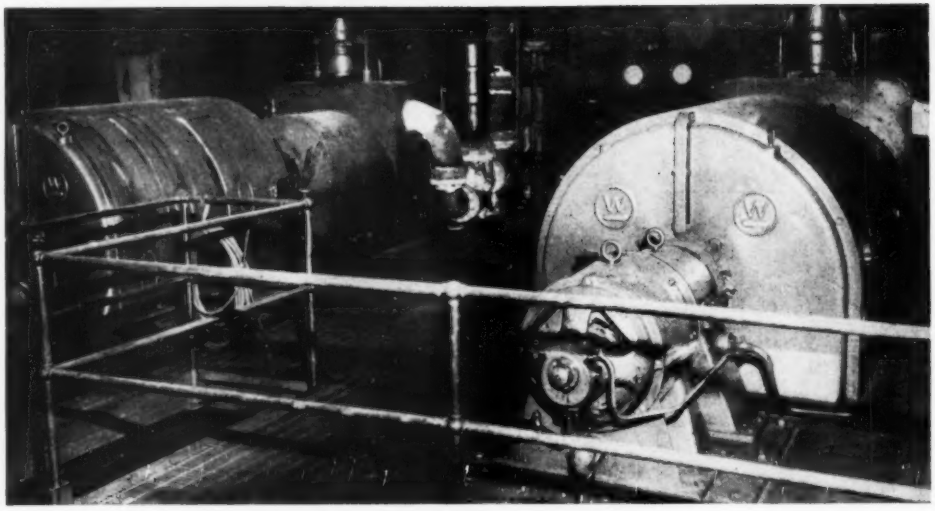
BELYEA CO. INC.

Main Office and Shop

43 HOWELL ST., JERSEY CITY 6, N. J.
Phone—Journal Square 2-3334
Also N. Y. City Line—Rector 2-7150

2 NON-CONDENSING

VERY MODERN
2500-KVA TURBO-GENERATORS



Above Cut Made from Photograph taken January 1949.
Illustrates our 2-2500-KVA., Westinghouse Turbine-Generators (Duplicates).
They are Very High Grade (new 1935) modern machines, 250# psi. 15/25# Back, 3/60/2300-v.

SPECIALS Turbo-Generators SPECIALS

2—NEW, NEVER ERECTED 5714-KVA., G.E., 600#-psi., 825° FTT., Condensing, 3/60/2300-v. NEW

1—6250-KVA., G.E., Surf. Cond., 200#-psi. 609° FTT. 3/60/2300-v. Complete Installation

1—3750-KVA., West., Surf. Cond., 200#-psi., 3/60/2300-v. Complete Installation: No. 1 Machine

15—OTHER COMPLETE INSTALLATIONS OF TURBO-GENERATORS, CONDENSING AND NON-CONDENSING, CAPACITIES FROM 450-KVA., to 4000-KVA. ALL HIGH GRADE UNITS: IMMEDIATE DELIVERY.

ALWAYS GET WEAVER'S PRICES: ARE BIG MONEY SAVERS

WIRE WRITE OR PHONE

CHARLES WEAVER

Electrical-Mechanical Engineers

41st Floor, Penobscot Building Detroit 26, Michigan

Telephones:
Woodward 1-1340
" 1-1341
" 1-6038

SEND FOR NEW STOCK LIST — JUST OUT — No. 400: IS FREE

POWER EQUIPMENT—READY TO SHIP

SAVE OVER 50% ON NEW INDUSTRIAL BLOWERS AND VENTILATING FANS

AXIAL FLOW VENTILATING FANS

1—16000 CFM Buffalo Forge Co., 3" stat. pres. 1800/1200 rpm. con. 15/4.5 HP., 1710/1150 rpm., 3 ph. 60 cy. G.E. A.C. Motor 220/440 v. totally encl.

1—12000 CFM 3" stat. pres. Sturtevant with dir. con. 10/3 HP., 1775/1180 rpm., 220/440 v. West. CS. TEFC Motor.

25—6000 cfm Sturtevant Bulletin 512389, 3" stat. pres. 7 blade, dir. con. 5/1.5 HP., 1765/1175 rpm., 220/440 v. 3 ph. 60 cy. West. TEFC Motors.

2—5000 cfm Sturtevant 1.8 stat. pres. 4.2/1.25 HP., 1750/1150 rpm., 3 ph. 60 cy. 220/440 v. ball bearing motors.

2—4000 cfm 3" stat. pres. Sturtevant dir. con. 2 speed, TE Westinghouse 220/440 v. Motors.

BRAND NEW TURBO SET

Westinghouse Steam Turbine consisting of 200 kw., 220/440 v., 3 ph. 60 cy. 1200 rpm., 80% P.F. A.C. Generator—40 kw., 120 v. 1200 rpm., D.C. Exciter and Westinghouse Reduction Gear. — Non-condensing.

A.C. MOTORS—3 PH. 60 CY.

No.	H.P.	Make	Type	RPM	Volts
1 new	500	Elec. Mach.	Syn.	120	4000/2200 220/440
3	300	Elec. Mach.	Syn.	720	2200
1 new	200	Westing.	Syn.	1200	440/220
2	250	G.E.	I	1200	2200
1	200	West.	CS	900	4000/2300
2	200	G.E.	I	860	2200
1	200	West.	CS	900	440
1	175	West.	MS	900	220
1	150	West.	MS	900	220
1	150	West.	Syn.	600	220/440
1	150	West.	Syn.	257	220/440
4	150	L. Allis	Splash Proof	1800	220/440
1	150	West.	CS	580	4000/2300
1 new	150	Elec. Mach.		720	4160/2300
1 new	125	Elec. Mach.		580	4160/2700
1	125	Elec. Mach.	Syn.	164	220/440
1	100	Reliance	IT	495	220/440
1	100	Allis Chal.		1200	220/440
1	100	West.		1200	220/440
2	100	Louis Allis	OGS	1750	220/440
5	100	Louis Allis	PA	1750	220/440
1	75	Stanley		600	220/440
1	75	Chandey	Syn.	600	220/440
1	75	Elec. Mach.	Syn.	900	220/440
1	75	Louis Allis	OGS	1200	220/440
2	75	Louis Allis	PAA	1150	220/440
1	75	G. Elec.	KT-543	1150	220/440
3	75	Armour	AXB	1180	220/440
1	75	Burke	EM-7	1200	220/440
2	75	West.	CS	1800	220/440
1	60	Burke	EM-7	900	220/440
1	60	G.E.	KT-543	900	220/440
3	60	Armour	AXB	900	220/440
1	60	West.	CS-658	1200	220/440
1	60	G.E.	KT-533	1800	550
1	50/32	G.E.	P08	800/640	220/440
1	50	West.	CS-658-A	870	220/440
1	50	Fynn-Weis.	22-V	900	220/440
2	50	G.E.	KT-346	900	220/440
1	50	G.E.	KT-342	1200	220/440
1	50	West.	CS	1200	220/440
1	50	American		860	220/440
1	50	West.	M-S	1800	220/440

A. C. GENERATORS—3 ph. 60 cy.

No.	KVA	Make	RPM	Volts
1 new	450	Elec. Mach.	120	4000/220 220/440
1 new	250	West.	1200	220/440
1	100	Elec. Mach.	164	220/440
1	100	West.	600	220/440
1	75	Elec. Mach.	900	200/440
1	50	G.E.	1200	220/440
1 new	50	Elec. Mach.	1200	220/440
1	37½	Ft. Wayne	1200	200/440
1 new	25	G.E.	900	220/440
	25	O'Nan	1800	220/440

BARGAIN — FOR SALE
100 KW. DIESEL ENGINE GENERATOR SETS

10—100 KW, 120/240 V D.C. Delco Generators dir. con. to 150 HP., Model GBD-8, 5½x7, 8 cyl. Superior Diesel Engines, elec. starting with muffler, power panel and accessories.

1—100 kw 220/440 V AC same as above.

Practically as good as new—Only Used for Spares.

250 VOLT D.C. GENERATORS

No.	KW	Make	Type	RPM
3	250	West.		1200
1	200	West.	SK	500
1	110	West.	SK-190	700
8	100	Reliance	1050-T	580
1	100	West.	SK-183	720
1	100	West.	SK-190	720
1	100	West.	SK-180	900
6	100	Delco		1200
1	100	G.E.	RC-58	850
1	100	West.	SK	850
1	100	G.E.	RCP-36	2100
1	75	Allis Chal.		850
2	75	West.	SK	1400
1	60	West.	SK	2100/1950
1	60	West.	SK-153	1100
1	50	West.	SK-180	400
1	50	G.E.	DLC-203	850
1	50	West.	SK-143	1100

MOTOR GENERATOR SETS—250 V.D.C.
Motors 220/440 volt or 2200 volt 3 phase, 6 Cycle

No.	KW	Make	RPM
3	250	Westinghouse	1200
1	200	Westinghouse	720
2	200	Westinghouse	1200
1	100	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	580
1	100	Delco	1200
2	90	Westinghouse	680
4	75	Westinghouse	720
1	75	Westinghouse	1200
1	60	Westinghouse	1200
1 NEW	50	General Electric	1800
3	40	Westinghouse	900
2	30	Westinghouse	720

VARIABLE SPEED MOTORS—230 V. D.C.

No.	HP	Make	Type	RPM
1	200	West.	SK	400/1000
8	100	Reliance	1050-T	400/1000
1	100	G.E.	RC	650/1200
2	100	West.	SK-183-A	575/1150
1	100	West.	SK-190	500/1000
1	100	West.	SK	600/1200
1	75	West.	SK	1100/1800
2	75	West.	SK	850/1700
1	50	West.	SK-180	320/960
1	50	West.	SK	300/1200
1	50	West.	SK-191	350/1050
1	50	West.	SK-143	850/1750
1	40	Allis Chal.		400/1200
2	30	G.E.	DLE-50	400/1200
1	30	G.E.		800/1200
1	25	G.E.	CD-123	300/1200
1	20	West.	SK-123	400/1600
1	20	G.E.	RF-11	500/1500

SPECIAL BARGAIN AIR COMPRESSOR

6—240 CFM Westinghouse type 3 VS-23 3 cyl. vert., 150 lbs. pres. dir. con., to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West Slip Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

SLIP RING MOTORS—3 ph. 60 cy.

No.	H.P.	Make	RPM	Volts
2	800	West. CW	507	660
1	600	G.E.-MT-415	900	2200/4000/220/440
1	350	West. CI	1150	220/440
1	300	West. CI	1150	220/440
1	250	Allis Chal	870	2200
1	250	West. CI	1150	220/440
1	250	West. CW	1800	220/440
1	200	West. CW	1800	220/440
1	150	West. CW	1150	2200/220/440
1	125	West. CW	860	2200/220/440
1	100	West. CW	720	2200/220/440
1	100	Triumph C-17	580	550/440/220
1	75	G.E. I-M	600	550/440/220
1	75	G.E. I-M	720	220/440
1	75	West. CW	1800	220/440
1	60	West. CW	900	220/440
1	60	G.E. IM	720	220/440
4	50	West. CW	870	2200/220/440

25 CYCLE A. C. MOTORS
3 ph. — 220-440 volts

H.P.	Make	Type	RPM
300	G.E.	MT-415	375
150	West.	CW	400
75	West.	MS	400
75	G.E.	M	715
60	West.	CS	1450
50	L. Allis	OGS-115	730
50	Armour	AB-1	720
50	West.		475
40	West.		725
25	West.	MS	715
20	West.	CS	715
20	Allis Chal.		715
15	Allis Chal.		1450
10	West.	CS	725

REDUCED VOLTAGE STARTERS—220 V. 3 ph. 60 cy.

7—100 H.P. Westinghouse Class 11-400

HUNDREDS of A.C. & D.C. BRAND NEW STARTERS all sizes—Gov. Surplus—BARGAIN PRICES

FREQUENCY CHANGERS

1—25 kw., 220/440 v. 3 ph. 180 cy., G.E. dir-con. to 25 HP., 1800 rpm., 220/440 v. 3 ph. 60 cy. motors.

SYNCHRONOUS MOTORS

1—New 500 HP., Elec. Machy. Co. 2200/220 or 440 v. 120 rpm.

ENGINE GENERATOR SETS

10—NEW 1 kw. 14.25 v. D.C. and 2 kw., 28.5 v. D.C. Homelite portable gas eng. Gen. sets. Can furnish lamps and batteries. Suitable for farms and camps.

3—5 kva. 120/240 v. 1 ph. 60 cy. Witte Diesel.

2—37½ KVA 220/440 volts 3 ph. 60 cy. Buda DIESELS

1—125 kva. 220/440 v. 3 ph. 60 cy. 257 rpm., Erie Ball STEAM.

1—125 kva. G.E. 220/440 v. 3 ph. 60 cy., dir. con. Skinner UNIFLOW Engine.

INDUCTION HEATING CONVERTER

New Van Norman, type indoor, floor, hi-freq. 32 kw. 220 v. 1 ph., 60 cy. 150 A. enclosed type.

HOISTS or WINCHES

200—1½ Ton HAND CRANKED ratio 27:1 thru an enclosed double reduction gear unit with 4 planetary gears mounted on steel plate complete with 48' of ¼" cable, ratchet type brake, push button release.

GEAR HEAD MOTOR

50 HP., G.E. 220/440 or 550 v., 3 ph. 60 cy., 1755 to 13 rpm., splash proof, ball bearing.

PORTABLE COMPRESSOR

1—315 CFM Ingersoll Rand portable 100 lb. pres. driven by 105 HP Waukesha Oil Engines, 860 rpm.

FOR SALE OR RENT

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

SEARCHLIGHT SECTION

Our 43rd Year

WAGNER

Quality and Service

"CERTIFIED REBUILT"

THE MARK OF DEPENDABLE ELECTRICAL EQUIPMENT

MOTORS . . . GENERATORS . . . M-G SETS

PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PARTIAL STOCK LISTING—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

250 KW Allis-Chalmers M-G Set, DC 120/240V. output, 363 H.P. Synch. Motor, 3 60 440V. 1200 RPM, AC & DC panels, late model.

M-G SETS

KW	Mfr.	Input V	Output V
200	Ridgeway*	2300/4000 AC	550 DC
200	Gen. Elec.	220/440 AC	125/250 DC
150	Cr. Wheeler*	220/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Gen. Elec.*	220/440 AC	250 DC
100	Gen. Elec.*	220/440 AC	125 DC
75	Star b.b.*	220/440 AC	250 DC
75	Star b.b.	240 DC	230/460 AC
75	Gen Elec. (2)	220/440 AC	125 DC
50	Gen. Elec.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
40	Gen. Elec.	220/440 AC	120 cycle
40	Northw'n Conv.	220 AC	230 DC
35	Gen. Elec.	220/440 AC	48 DC
30	Ideal	220/440 AC	125/250 DC
30	Elec. Prod.*	220/440 AC	50 DC
20	Whse.	220/440 AC	250 DC
15	Gen. Elec.	220/440 AC	125 DC
10	Allis Ch. (2)	220/440 AC	250 DC

*Synch. motor drive.

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	230	800
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1000
75	G.E. New b.b.(2)	CDM	230	1755
75	Cr.W. New b.b.(3)	CMC	230	1150
75	Allis Ch.	E	230	500
75	Whse.	S13L	115	570
75	Gen. Elec.	BRC	115	1150
75	Northw'n	K20	230	1750
60	Gen. Elec.	RC36	230	650
60	Elec. Dyn.	25-S	230	450/900
60	Whse.	SK	230	1700
60	F. Morse b.b.	DH	230	1150
50	Gen. Elec.	RC33	230	1100
40/60	Whse. (2)	SK170	230	500/1000
40	Sprague dyna.	LC	230	750/2000
35/50	Gen. Elec.	CD123	230	575/1150
35	Ideal	DV350	230	400/1200
30	Whse.	S-7	115	900
30	Gen. Elec.	RC31B	230	1150
25	Gen. Elec.	RC31	230	1150
25	Sprague dyna.	LC	230	750/2000
25	Cnand'son(4)	C13	115	850
25	Gen. Elec.	CD85	230	1750
20	Gen. Elec.	RF12	230	400/1600
20	Whse.	SK93	230	1150
20	G.E. b.b. NEW	CDM83	115	1750
20	Gen. Elec.	RC11	115	1150
20	Reliance	T	230	850
20	Gen. Elec.	DLC	230	500/1500
20	Gen. Elec.	DC85	230	1150
15	G.E. b.b. NEW	CDM67	115	1750
15	Whse.(5)	SK90	230	825
15	El. Dyn. b.b. (2)	326	230	1750
15	Whse. (2)	SK80L	230	1150
15	Star b. b. (4)	SQ	230	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	250	1200
105	Century b.b.	1500	70	1200
100	Gen. Elec.	RC17	125	1200
100	Gen. Elec.	C	250	750
75	Allis Ch.	E	250	750
75	Whse.	S	125	600
75	Cr. Wheeler b.b.	CCD	250	1450
75	Gen. Elec. (2)	RC36	125	1200
50	Gen. Elec.	RC36	250	1250
50	Gen. Elec.	RC	250	1250
30	Elec. Prod.	BF	50	1150
30	Gen. Elec.	RC	250	1500
30	Ideal 3 wire	HHR	125/250	850
20	Reliance	T	250	1150
15	Star b. b.	late	250	1750

EXPLOSION PROOF MOTORS

from 1 to 20 H.P.....std. speeds

Turbo-Generator Bargain!

375 KVA Whse. 3 60/240 480V. Non-Cond.

A. C. MOTORS—25 CYCLE

H.P.	Mfr.	Type	Volts	Speed
150	Whse.	HF	440	500
150	Gen. Elec.	IK-16	440	750
50	Allis Ch.	ANY	440	750
50	G.E. int.	MTC5337	440	750
50	G.E.	I-K	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr.	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
375	Whse.	G	240/480	900
300	Gen. Elec.	ATB	240/480	720
250	Whse.	G	2300	600
200	Gen. Elec.'	ATB	240/480	600
156	G.E. 1 brg.	ATB7558	240/480	1200
150	Gen. Elec.	ATB	2300	450
125	Gen. Elec.	ATB	240/480	300
100	Whse.	G	2300	900
100	Gen. Elec.	ATB	240/480	1200
63	El. Machy.	180 cy.	240/480	1800
56	Gen. Elec.	ATB	240/480	900
50	Allis Ch.	B	240/480	1200
25	Gen. Elec.	ATB	240/480	1200
25	Whse. b.b.	1 ph.	120/240	900
12½	Whse. b.b. NEW		240	1200

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	450	Whse. 2200 V.	CW	600
2—	300	Allis Ch. 2200 V.	ANY	720
1—	300	G.E. 2200 V.	I-M	1800
1—	150	Gen. Elec.	M-16	600
1—	150	G.E. 2200/4000 V.	I-M	1200
1—	150	G.E. int. duty	ITC-15	720
1—	150	Allis Ch.	ANY	600
1—	125	Gen. Elec.	IM-15	720
1—	100	Allis Ch.	ANY	1800
1—	100	Al. Ch. b.b. NEW	ARY	600
1—	100	Allis Ch.	ANY	720
1—	100	Whse. int. 2200 V.	CI856C	600
1—	100	Whse. int.	CI-756A	720
2—	75	Gen. Elec.	IM-14	720
1—	75	G.E. int.duty	MTC5342	900
1—	75	Ideal int.	AVE	1200
1—	75	Gen. Elec.	MT358	600
2—	75	Gen. Elec.	IN-14	600
1—	75	Gen. Elec.	MT337	1800
2—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Fair. Morse	BV	720
1—	50	Gen. Elec. int.	ITC	600
1—	50	Whse. int.	CI	600
1—	50	Gen. Elec.	I-M	720
1—	40	Gen. Elec.	MT336	900
1—	40	Gen. Elec.	MT327	1800
1—	37	G.E. int.	ITC	600
1—	30	Gen. Elec.	OMT336	1200
1—	30	Gen. Elec.	MT346	600
1—	30	Gen. Elec.	MT326	1200
2—	25	Gen. Elec.	MT332	900
1—	25	Triumph	SR	1200
1—	25	Gen. Elec.	I-M	600
1—	20	G.E. int.	MTC5312	900
1—	20	Gen. Elec.	MT326	900
2—	20	G.E. int.	MTC5302	1200
1—	15	P & H b.b. int.	W7	1200
14—	10	Reliance New b.b.	AW-324	1800

A. C. MOTORS—SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
667	Gen. Elec. .8 PF	AII	2300	450
600	Whse.		220/440	900
300	Whse.	G	2300/440	900
250	Ideal	2BC-M4	2200	450
220	G.E. 3 brg. .8 PF	A11	220/440	600
160	Gen. Elec. .8 PF	AII	2300	450
130	Gen. Elec.	AII	220/440	300
125	Whse.		2300	900
125	G.E. spipri. .8 PF	TS955	220/440	1200
100	American b b.	YGH	220/440	900
108	Gen. Elec.	AII	220/440	1.00
60	Gen. Elec.	AII	220/440	900

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	300	Gen. Elec.	IK-16	1200
2—	200	Reliance b.b. NEW	C8085	1800
1—	200	Allis Ch.	AN	1200
1—	200	L. Allis 2200/3800 V.	OGE-144	900
1—	150	Allis Ch. 2200 V.	b.b.	720
1—	150	Reliance b.b. NEW	14C6085	720
1—	150	Whse. 2200 V.	CS771-1C	1800
1—	150	Reliance b.b. NEW	B6085	1200
1—	150	Gen. Elec.	IK-15	900
1—	150	Reliance b.b. NEW	B6085	900
1—	125	Reliance b.b. NEW	C5085	1200
2—	125	Allis Ch. 2200 V.	AN	1200
1—	125	Gen. Elec.	IK-16	450
1—	125	Cont. 2200 V. b.b.	SC	1800
2—	125	Rel. TEFC NEW	B6085	1800
1—	100	Gen. Elec. b. b.	FT556	900
1—	100	Gen. Elec.	IK	900
4—	100	Allis Ch. 2200 V.	AR226	1200
1—	100	Reliance b.b. NEW	C5085	900
1—	100	Elec. Machy.	b.b.	1200
1—	100	Rel. TEFC NEW	C5085	1200
1—	100	G.E. b.b. NEW	K504S	1800
1—	100	Cont. TEFC	NP682	1200
1—	75	Reliance b.b. NEW	C5084	900
1—	75	Gen. Elec.	KT552	900
1—	75	Reliance TEFC NEW	C8084	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT329Y	3600
1—	75	Whse. hitorq	CS-607	1200
2—	75	Reliance b.b. NEW	C505	1200
1—	60	Gen. Elec.	KT346	900
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Rel. TEFC NEW	C505	1200
2—	60	Reliance b.b. NEW	C504	1200
2—	60	Whse. H. T.	CS504	1800
1—	60	Wagner b.b.	RP444	3600
1—	60	Allis Ch. 4000/2200 V.	AR823	1800
1—	50	Whse. b.b. NEW	CS405S	1800
1—	50	G.E. 2 phase	I-Q	900
2—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
2—	50	Gen. Elec.	KT336	1200
1—	50	Gen. Elec.	KT342	900
1—	50	Whse. hulip	WL607	900
2—	40	Gen. Elec.	KT527	1800
1—	40	Al. Ch. 3 speed	ARX	900/600/450
5—	40	Gen. Elec.	KT336	900
2—	40	Reliance b.b. NEW	C404	1800
2—	40	Rel. TEFC NEW	C445	1200
3—	40	G.E.	KT532	1200
2—	35	Gen. Elec.	I-K	720
2—	30	Howell b.b. speed	SC	1800
2—	30	G.E. NEW b.b.	K365	1800
2—	30	G.E. NEW hitorq	KG365	1800
2—	30	G.E. TEFC b.b.	K404	1800
1—	30	Gen. Elec.	I-K	900
1—	30	Gen. Elec.	KT336	720
1—	30	Wagner	22T8F	900
1—	30	Whse.	CS646	900
2—	30	Reliance b.b. NEW	C405	1200
2—	30	Reliance TEFC NEW	C444	1200
1—	30	Cr. Wheeler b.b.	SC30Y	1800
2—	25	Gen. Elec.	KT326	1200
2—	25	Rel. TEFC NEW	C444	900
3—	25	Reliance b.b. NEW	C364	1800
2—	25	Reliance TEFC NEW	B365	1800
2—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
2—	25	Whse. NEW spl. b.b.	CS365	1800
3—	25	Whse.	CS646	900
2—	25	Gen. Elec.	I-K	600
1—	20	Reliance b.b. NEW	C404	900
1—	20	G.E. TEFC b.b.	K404	1200
4—	20	Reliance b.b. NEW	C364	1800
2—	20	L.A. NEW exp. prf.	EX364	1800
2—	20	Whse. NEW b.b. spl.	CS364	1800
2—	20	Gen. Elec.	KT312	1200
1—	20	Whse.	CS	1200
2—	20	G.E. NEW b.b.	K365	1200
2—	20	Diehl TEFC NEW	INF364	1800
2—	20	Century b.b. 4 spe d	SC594	1800
4—	15	G.E. NEW b.b.	K324	3600
2—	15	Whse. NEW TEFC	CS326	1800
1—	15	Gen. Elec.	KT512	900

ARTHUR WAGNER COMPANY

1432-38 W. RANDOLPH STREET CHICAGO 7, ILL. MONroe 7409

L. J. LAND
Guaranteed Electrical Equipment

1 YEAR GUARANTEE

RELIABLY REBUILT—DEPENDABLE EQUIPMENT

PARTIAL LISTINGS ONLY

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed
450	G.E. vert.	KF-6339	1180
250	G.E.	IK	1160
250	G.E. (2)	K-568	575
200	G.E.	KF-6335Z	880
147	West.	25 cy.	1750
125	Al. Ch. (2)	AR-630F	450
100	G.E. (2)	K-544	1175
100	West.	CS	870
100	G.E.	KT-456	865
100	West. (2)	CS	690
75	West.	CS-503S	1760
75	West.	CS-662-C	1150
75	West.	CS	670
60	West.	504-S	1750
60	Rel.	AA-C5084Z	870
50	G.E.	FTR-523	3600
50	Elliott	198	3450
50	G.E.	K-445	1170
50	West.	CS	890
40	G.E.	KT-336	900
40	West.	CS	900

SLIPRING MOTORS

600	Cr. Wh.		514
200	G.E.	MTP	1800
180	G.E.	MT-564Y	580
100	G.E.	IM	1800
100	Al. Ch.		690
75	G.E.	IM	870
75	G.E.	IM	690
60	Al. Ch		690
60	G.E.	M-6326TEFC	705
50	West.	CW-544	1155
50	Al. Ch.	ARY	575
50	F-M	RY	575
50	G.E.	IM	490
40	G.E.	IM	1200

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
800	G.E.	TS	900
400	G.E. (4)	TS-8325	600
380	G.E.	TS	900
200	Ideal (2)		257
180	G.E.	AT1	900
150	G.E.	AT1	720
150	G.E.	TS	1200
125	West.	G	1200
100	Elec. Prods.		1200

A. C. GENERATORS

288 KVA	West.	G	900
400 KW	West.	G	1200
75 KW	G.E.	ATB	380
75 KW	G.E.	ATB	1200

D. C. to A. C. GENERATORS

K.W.	Make	D.C.	A.C.
25	G.E.	230	220
25	Star	115	120
25	Ideal	115	440
25	El. Mchy.	230	440
7½	Hertner	115	440
5	El. Spec.	110	110

600 V. GENERATOR

K.W.	Make	Speed
200	Cr. Wh.	900
30	Burke	1750
30	E.D.	1150

250 V. GENERATOR

K.W.	Make	Speed
500	West.	1100
330	Elliot	1200
300	G.E.	1200
300	Al. Ch.	1200
200	G.E. MPC	1200
150	West.	900
150	West.	1180
150	G.E.	900
50	G.E.	1200
30(3)	G.E.	1780
30	Cont.	1200
25	G.E.	1200
15	G.E.	1750
10	Star	1750
7½	West.	1200
5	West.	1750

125 V. GENERATOR

K.W.	Make	Speed
250	G.E.	720
150	Cr. Wh.	1200
150	West.	1150
100(2)	West.	900
100	G.E.	1200
100	El. Mchy.	1200
75	Cr. Wh.	1200
75	Hertner	1150
50	Sturt.	2800
40	Cent.	1450
30	Ideal (2)	1750
30	L.A.	1450
30	G.E.	1150
20	Delco	1200
15	G.E.	1150
10	Rogers	1450
7½	West.	1200
5	G.E.	1750

LOW VOLTAGE GENERATOR

Amp.	Make	Voltage
8000	H-V-W	6/12
5000	M-B-O'C(2)	6/12
2000	H-V-W	6/12
1000	Chandeysson (2)	6/12
1000	Col.	6/12
125	Hobart(8)	7½
3000	Chandysson	12/24
1000	H-V-W	12/24
300	Star	15
67	Cont.	15
750	Star	15
1000	G.E.	15
800	G.E.	22.23
600	Rel.	24
134	West.	24

LOW VOLTAGE GENERATOR (Cont.)

175	Cr. Wh.	25
550	Col.	27
1600	G.E.	30
800	G.E.	30
100	G.E.	30
200	West.	30
205	G.E.	32
1000	G.E.	33
1000	Chandysson (4)	40
500	Chandysson (3)	40
205	G.E.	42
24	G.E.	44/54
75	G.E.	50/10
800	G.E.	50

550 V. D. C. MOTORS

H.P.	Make	Type	Speed
765	G.E. (6)	MPC	1845/1350

230 V. D. C. Variable Speed Motors

100	Rel.	1050-T	400/1200
100	G.E.	CD-173	400/1200
75	G.E.	D	500/1500
75	Cr. Wh.	CMC-125H	375/750
60	G.E.	C	480/1100
55	Cr. Wh.	CCM-125H	185/500
50	West.	SK	500/1500
50	West.	SK	250/1000
40	Reliance	461T	400/1200
40	G.E. (3)	CD-1441	400/1500
25	West.	SA	500/1500
25	Rel.	185-T	500/1500
25	G.E.	RF-13	400/1600
25	G.E.	RF-14	400/1200
25	G.E.	RP-14	300/1200
20	G.E. (6)	RP-12	400/1200
20	West.	SK	375/1500
15	West. (4)	SK-95	600/1500
15	E.D.		500/1500
15	West.	SK-120	350/1000
15	West.	SK	250/1000
15	West.	SK	500/1800
10	G.E.	RP-10	600/1800
10	G.E.	CD-93	600/1800
10	West.	SK	600/1200
10	West. (3)	SK	500/1800
10	G.E.	RP	400/1600
10	G.E. (3)	RF	400/1200
10	Rel.	131-T	250/1000
7½	West.	SK-70	500/1500
7½	G.E.	RP-10A	450/1600
7½	Al. Ch.		250/1050
5	West. (2)	SK-80	500/1500
5	G.E.	RF-9	450/1800
5	G.E.	RF	450/1800
5	Rel. (2)	46-T	400/1600

230 V. D. C. MOTORS

150	G.E.	RC-19	800
125	GE	CDF125	1300/1750
100	G.E.	RC-14	1750
75	West.	SK-170	625
75	West. (2)	SK-180	475
75	Cr. Wh.	52-BM	480
60	West. (2)	SK-160	680
50	West.	SK-138	1300
50	Diehl	K-10	850

230 V. D. C. MOTORS (Cont.)

50	West.	SK	750
50	West. (2)	SK-150	585
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC	1750
40	G.E.	RC-32	1100
40	G.E.	RC-13	1075
30	G.E. (2)	RC	1200
30	West (2)		975
30	G.E. (2)	RC-33	775
30	West. (2)	SK-148	575
20	G.E. (2)	CD-83	1750
20	G.E. (2)	RC-11	1150
20	Star (2)	SR-316	29.2

115 V. D. C. MOTORS

300	West.	SK	900
100	Cr. Wh.	CMC	900
25	G.E. (2)	CD	1800
25	Cr. Wh.	CCM	750
20	Century	R8	1750
20	G.E. (2)	CD-83	1750
20	West.	SK-110L	750
12½	G.E.	CDM-85	930/1160

TRANSFORMERS

300 KVA—Al. Ch. 3 phase, 4160 V. primary 230 V. secondary.
300 KVA—Pittsburgh, 3 phase, 4160 V. primary, 230 V. secondary.

NEW D. C. STARTERS

150—230 V. Magnetic 5 H.P. to 75 H.P. G.E.—C-H—A-B—W.L., etc.
100—230 V. Manual and Compound 1 H.P. to 5 H.P.—G.E. & C-H.
40—7½ H.P. 230 V. C-H—Magnetic reversing.

A. C. STARTERS

1—475 H.P. West. Magnetic Reduced voltage, 550 V. synch.
4—400 H.P. 440 V. C-H Bal. 9876 Mag. Red. Volt. Synch.
1—250 H.P. C-H 4150 V. synch. full voltage.
1—150/200 H.P. G.E.—440 V. CR-7062 Syn.
3—150 H.P. G.E. 220 V. Cr. 7061 Synch.

NEW A. C. STARTERS

40—C-H. & A-B 2 and 4 speed Magnetic up to 25 H.P.
20—50 H.P. C-H, 440 V. Magnetic.
165—20 H.P. W.L. 440 V. Magnetic.
635—7½ H.P. C-H. 440 V. Magnetic.

AIR COMPRESSORS

425 Cfm. Sullivan 2 stage.
360 Cfm. American 125 lbs.

ELECTRIC & AIR HOISTS

17—2 ton Shepard-Niles 230 V. D.C.
8—500 lbs. P & H. Zip Lift, 3 phase.
2—2 ton Yale & Towne, 3 phase.
1—1 ton Shepard-Niles, 3 phase.
1—½ ton Yale & Towne, 3 phase.
1—2 ton Thor, pneumatic.
1—½ ton Thor, pneumatic.

400 CY. GENERATORS

2—3 K W GE 3/400/115.
1—7½ K W GE 3/400/240.
1—10 KW GE 200/700 Cy.
1—15 KW GE 3/400/240.

EST. 1910 — L. J. LAND INC. — 40th YEAR

156 GRAND STREET — Phone CAnal 6-6976 — **NEW YORK 13, N. Y.**

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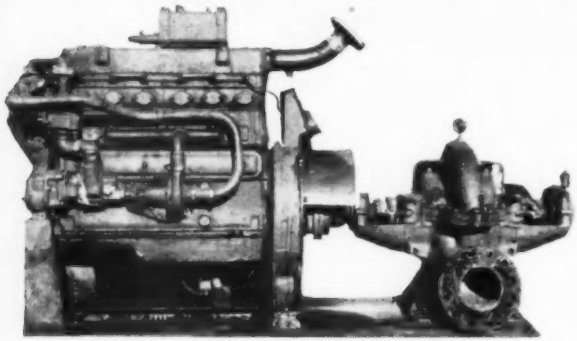
Phone Liberty 2-4300

South Western Representative
1400 Carr St., HOUSTON, TEXAS
Phone: Charter 4-6558

Pennsylvania Office
10th and Exeter Sts., READING, PA.
Phone Reading 2-6866

LIQUIDATION SALE—Modern Equipment



Diesel Driven Fire Pump 1000 GPM, 280 Ft. Head

CONDENSERS

(Most are new)

No.	Sq. Ft.	Make	Passes	Tubes
1	8533	Bethlehem	1	Brass ¾"
4	3300	Str. Wells	2	Alu-Brass ¾"
1	2200	Alco	2	Cu Ni ⅝"
4	1050	Conseco	2	Cu Ni ⅝"
1	750	Bethlehem	2	Brass ⅝"
30	400	All. Chalm	2	Brass ⅝"
4	300	Wheeler	2	Cu Ni ⅝"
8	155	Conseco	2	Brass ¾"
44	349	Luboil Coolers		Cu Ni ⅝"

MOTORS

3 Ph. 60 Cy.

6—3800 HP 1700 V 257 RPM G.E.
5— 700 HP 2300 V 128 RPM D.C.
1500 HP 525 V DC 600 RPM W'hse.
667 HP 374 V DC 1300 RPM Elliott
444 HP 250 V DC 900 RPM Elliott
222 HP 230 V DC 3050 RPM W'hse.
15 HP 120 V DC 500 RPM Diehl

GENERATORS

1200 KW 525 V DC 750 RPM All. Chalm.
1075 KW 375 V DC 750 RPM Elliott
700 KW 240 V DC 500/720 Elliott

TURBO-GENERATORS—A.C.

1—1000 KW All. Chalmers 3/60/600, 3600 RPM, cond., 140# steam press.
2—250 KW G.E. type AT1 3/60/450, 1200 RPM, cond.
2—200 KW Westinghouse, 3/60/450, 1200 RPM cond. (NEW).
6—200 KW G.E. type ATB 3/60/450, 1200 RPM cond. and non-cond.
2—132 KW G.E. type ATB 3/60/450, 1200 RPM, cond.

TURBO-GENERATORS—D.C.

KW	Volts	Winding	Speed	Type
2—375	180/240	Shunt.	1200	non-cond.
5—300	120	Compd.	1200	cond.
1—300	120/240	Compd.	1200	cond.
2—250	240	Compd.	1200	cond.
12—150	120	Shunt.	1200	cond.
12— 60	120	Stab. Sh.	1800	cond.
3— 25	120	Stab. Sh.	1200	cond.

PUMPS

No.	Make	GPM	Press.	Drive	Application
1	Worthington	425		282 HP turbine	Boiler Feed Pump
1	Worthington	750	375#	265 HP turbine	Boiler Feed Pump
4	Worthington	90	550#	for motor drive	Boiler Feed Pump
5	Aldrich	450	2500#	700 HP 3/60/2300	Hydraulic Pumps
1	Worthington	375	625#	222 HP 230V DC	Hydraulic Pump, new
2	Gardner Denver	1000	280 ft.	95 HP Buda Diesel	Fire Pumps
2	Allis Chalmers	1000	280 ft.	90 HP Herc. Diesel	Fire Pumps
30	W. S. Darley	750	200#	gasoline engines	Fire Pumps, new
1	Worthington	500	200 ft.	50 B.H.P.	Fresh Water Pump
1	Gardner-Denver	2850	63 ft.	50 HP 3/60/220	Water Pump, new
2	Worthington	450	280 ft.	46 HP turbines	Water Pumps
10	Gardner-Denver	1500	56 ft.	30 HP 230V DC	Oil or Water Pump
10	Gould, fig. 3380-	250	225 ft.	30 HP 230V DC	Fire Pump
1	Worthington	350	65#	28 B.H.P.	Drainage Pump
1	DeLaval	195	75 ft.	27 HP 3/60/440	Condensate Pump
1	Weil	200	100 ft.	25 HP 125V DC	Fire Pump
1	Allis Chalmers	600	70 ft.	25 HP 3/60/2200	Fresh Water Pump
5	Ingersoll Rand	200	100#	20 HP 3/60/440	
1	Allis Chalmers	150	170 ft.	20 B.H.P.	Fresh Water Pump
4	Ingersoll Rand	140	187 ft.	20 HP 230V DC	Condensate Pumps, new
1	Warren	475	13#	16.9 HP turbine	Condensate Pump
2	De Laval	325	45#	15 HP 230V DC	Luboil Pump, new
1	Ingersoll Rand	600	56 ft.	15 HP 230V DC	Dist. circ. Pump, new
7	Worthington	500	125 ft.	15 B.H.P.	
4	Carling	150	117 ft.	9 HP turbine 150#	15# back pressure
6	Worthington	600	13.5#	9 HP 230V DC	dist. circ. pumps, new
1	Warren	165	50#	8.68 HP, 3/60/440	Condensate Pump
3	De Laval	540	15#	7½ HP 3/60/440	
2	Allis Chalmers	150	100 ft.	7½ HP 230V DC	
4	De Laval	6.5	450#	5 HP 230V DC	Fuel Oil Pumps, new
1	Ingersoll Rand	20	201 ft.	5 HP 230V DC	Condensate Pump, new
6	Gould, Fig. 3720	35	14#	3 HP 230V DC	new
10	National Transit	60	50#	3 HP 230V DC	Fuel Oil Pumps,
8	Chicago Pump Co.			3 HP 115V DC	Sewage ejectors, new

DIESEL ENGINES

HP	MAKE	MODEL	RPM	CYCLE	YEAR
1800	General Motors	16-2SB5	900	4	1943
1600	Fairbanks Morse	38D O/P	720	2	1944
1600	Hamilton	RB99-D.A.	700	2	1944
1600	General Motors	16-278A	720	2	1944
1200	General Motors	12-278A	750	2	1944
900	General Motors	12-567ATL	750	2	1942/44
500	Superior	6-cyl.	514	4	
300	Fairbanks Morse	38-O/P	1200	2	1936
150	Superior	GDB-8	1200	4	1942/44

DIESEL GENERATOR SETS

AC	200 KW	3/60/450	1200 RPM	General Motors	8-268A	1943 rebuilt
	100 KW	3/60/450	1200 RPM	General Motors	3-268A	1943 rebuilt
DC	1200 KW	525V	750 RPM	General Motors	16-278A	1943
	650 KW	240V	750 RPM	General Motors	12-567	1943
	125 KW	120/240	600 RPM	Superior	VDM8	
	100 KW	120/240	1200 RPM	Superior	GDB-8	1942/44
	100 KW	120/240	1200 RPM	General Motors	3-268A	1943/44
	10 KW	120	1200 RPM	Hercules	DOOD	1943

FORCED DRAFT BLOWERS

1—Forced draft blower, Sturtevant, Rex-vane, size 24, capacity 20,000 CFM, 17" S.P., max. 24,000 CFM, driven by Sturtevant turbine, 191 HP, 320# to 400# steam press., exh. press. 10#.

ICE PLANTS (New)

2—22 ton capacity, Freon 12, mfd. by Frick.

HOISTS

10—100,000# pull at 10 FPM to 3000# pull at 400 FPM. 2 Gypsies 12000# pull at 125 FPM, driven by 50 HP 230v. D.C. motors 525—1800 RPM.
15—15,000# pull at 78 FPM, 3360# pull at 348 FPM and 2 auxiliary drums. Driven by Chrysler 28.35 H.P. gasoline engines. (NEW).

WRITE OR CALL FOR DETAILS

HUGO NEU CORPORATION
31 Nassau Street New York 5, N. Y.
Tel. REctor 2-1334

ARRANGE FOR INSPECTION

GLOW

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh
400	1200	440	GE-I-17
350	3550	2200	Westgh.-CS
350	514	440	GE-I
300	900	440	GE-I-17
250	600	2300	Triumph
225	514	440	GE-I-14
200	490	2300	GE
200	600	440	Westg'h-CS
150	600	2200	GE
125	1200	440	Centure
125	900	440	Wgnr, 26VR3J1
125	340	220	A-C
100	1800	2300	Burke
100	1200	440	C-W
85	3600	2200	GE
75	1800	220/440	GE-K505S
75	900	2300	GE
75	720	2300	Wagner
60	3600	2300	GE-KT
60	1800	440	Al. Ch.
60	1800	2300	GE-FTR
60	1200	220/440	GE-K505
50	3600	440	R. & A.
50	1800	220	GE-KT
50	900	220	GE
40	720	2300	Wtg.-CS
40	900	2300	Wtg.-CS
40	900	220	Lincoln
40	720	440	GE-KT
30	1800	dual	Delco
30	1200	dual	Master
30	900	220	Al.-Ch.-AR, fr 220c
30	900	220	Wagner(HI-Torque)
30	720	220	GE-HJ
30	514	440	Stanley
25	3600	dual	L-A
25	1800	dual	GE
25	1200	220	Wesche
25	900	440	GE
25	900	220	Westgh.-CS
25	720	220	Wagner
25	600	440	GE-I
20	3600	dual	GE
20*	1800	220/440	Master
20*	1800	220/440	Wesche
20	1200	440	Al. Ch.
20	900	440	Wtg.-CCL
20	600	220	GE-KT

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125*	1200	440	GE-TE-FC-BB
60	900	440	GE-TE-FC-BB
30	1800	dual	Delco
30	1200	440	Wagner
30	900	440	Reliance, TE-FC-BB
20	3600	dual	Delco-TE-FC-BB
20	1200	440	Wagner
20	900	440	GE-TE-FC-BB
15	1800	dual	Delco
15	1200	220/440	Delco-TEFC-BB
15	900	440	GE, TE-FC-BB
10	1200	440	GE-TE-FC-BB
7½*	1800	dual	Wagner-TEFC-BB
7½*	1800	dual	Master-TEFC-BB
7½	1200	dual	GE-HI Slip-TEFC-BB
7½	1200	dual	Delco
7½	1090	220/440	GE-HI Slip
7½	900	dual	Delco-TEFC-BB
5	3600	dual	Delco-TE-FC-BB
5*	1800	dual	Master-TEI C-BB
5	1800	220	Wagner TE-BB
5*	1200	dual	GE-TEFC-BB
3	3600	dual	Delco, TE-FC-BB
3	1800	dual	Delco-TEFC-PB

*New Motor

ENCLOSED SQUIRREL CAGE—Cont'd.

HP	RPM	Volts	Make
3	1200	dual	Rel-TEFC-BB
3	900	dual	Delco
2	1800	dual	Delco-TEFC-BB
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
1½	900	dual	Delco-TEFC-BB
1½	1800	dual	L. Al-TE-BB
1½	1200	dual	Delco-TEFC-BB
1	3600	220	Haskins-TEFC
1	1800	dual	Master-TEFC-BB
1*	1800	dual	Delco-TE-BB
1*	1200	dual	Rel-TE-BB
¾	3600	4400	Delco-TE
¾	1800	dual	Wesche-TE-BB
¾	900	dual	Delco-TEFC-BB
½	1800	440	Delco-TE-BB
½	1800	dual	Delco-TE-BB
½	1200	220	Cr. Wh.-TE
½	900	dual	Delco-TE
1/3	1800	440	Delco-TE

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
400*	514	2300	C-W, Short Shaft
375	1800	2300	Al. Ch.
350	900	2300	Westgh.
250	300	2300	Al. Ch.
235	1800	220	GE-1
75	1800	220	GE
75	900	440	Al.-Ch., ANY
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Wesche
50	1800	220	GE-MT
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
40	1200	220	GE-MT-336
40	900	220	Wtg.-HF
40	720	2300	Wtg.-HF
40	720	220	Al. Ch.-ARY
40	600	2300	Al. CH.-ARY
40	600	220	Al. Ch.-ARY
40	450	220	Triumph-C
35	1200	220	Westgh.
35	900	220	Al. Ch.
35	900	2300	Ridgeway
35	720	220	GE
35	900	2200	GE
30	1800	2300	Wtg.-CW
30	1800	220	GE
30	1200	440	Wagner
30	1200	2300	Lincoln
30	900	22[illegible]	GE-MT
30	900	2300	F-M
30	720	220	GE-1
30	600	220	E. Morse-BV
25	1200	220/440	Watson-KH
25	600	220	Watson

VERTICAL MOTORS

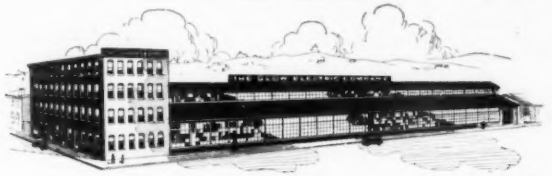
HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
150	1200	2200	GE-I-SR
60	1200	440	GE-Cage
125	1200	2300	Al. Ch.-SR
125	1200	2300	Al. Ch.-Cage
100	1200	440	GE-Cage
75	1200	dual	Westgh.-Cage
75	1200	2200	GE-Cage

VERTICAL MOTORS—Cont'd

HP	RPM	Volts	Make
75	360	220	Ideal-Cage
60	1800	230 D.C.	GE
60*	1200	440	Al. Ch.-Cage
50	1200	2200	Wtg.-Cage
50	800	440	Al. Ch.-Cage
40	1800	220	GE-Cage
40	1700	230 D.C.	GE
40	1200	440	Wtg.-SR
40	1200	2200	Westgh.-BB-Cage
35	1200	2300	Al. Ch.-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25*	1550	230 D.C.	GE
25	1200	2200	GE-Cage
25	850	230 D.C.	Wtg.
20*	1800	440	Al. Ch.
20*	1200	440	Al. Ch.-Cage
15*	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
15	600	440	Al.-Ch.
15	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
7½	1800	500 D.C.	Peerless
7½	900	440	Burke
7½	700	230 D.C.	GE
6	850	110 D.C.	Rel.
5	1400	230 D.C.	R. & M.
5	600	440	GE-Cage
4	1650	110 D.C.	Watson
3	1700	230 D.C.	Watson
3	1200	dual	Wtg.-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	GE-ATI
1015	500	2200	Wtg.-25 cycle
710	720	13200/6600	GE
500	514	440	GE
320	900	2300	GE-ATI
250	225	2200	GE-TS
220	600	2300	GE-ATI
200	720	440	GE-TS
200	225	2300	Wtg., rotor & stator only
160	900	440	GE-ATI
150	1800	2200	GE
150	1800	220	GE-ATI, Single Bearing
150	720	440	Westgh.
120	225	220	E-M, rotor & stator only
115	164	208	GE
95	1200	220	Burke
75	1200	220	Westgh.
75	900	2300	GE-ATI-7552
60	360	2200	GE, rotor & stator
50	1200	440	Wagner
50	900	220/440	Westgh.
50	720	440	GE-TS
50	360	440	GE, rotor & stator
30	900	440	Wagner
30	600	550	GE, rotor & stator
30	450	dual	Wtg., rotor & stator
30	360	550	GE
30	327	220	E-M, rotor & stator
25	1800	220	Wagner
25	450	220	E-M, rotor & stator
25	300	220	Ideal
20	1200	440	Wagner
20	900	220	Wtg.
20	600	220	E-M, rotor & stator
15	1800	220	Wagner
15	1200	440	Wagner
10	1800	220	Wagner
10	1200	220	Wagner
7½	1200	410	Wagner



D. C. MOTORS

115 Volts

HP	RPM	Description
225	750	GE-MPC
60	1200	Star
58	975	Northern
30	1800	F-M
30	200/600	Sprague
25	1150	Triumph
25	750	GE
20	700	Triumph
20	500/1500	GE-RF11
20	400/1200	GE-RLC fr 202A
18	600	Sturtevant MPS
15	1200	J. & L.
15	1000	GE-CE
15	975	F-M
15	725	Westgh.-S fr 6
12½	1150	GE-RC29
12	1075	J. & L.
12	530	Westgh.-SK-113
10	3450	Imperial
10	1800/3400	Star, SB-5
10	1200	J. & L.-CI
10	1200/1800	Reliance-78T
10	650	J. & L., type C1
10	400/1600	Watson-BW15B

SPECIAL SUB-STATION

G. E. Double ended Load Center, Unit Sub-Station complete with:

2—Pyranol Filled, indoor type transformers each rated 1000 KVA, 13800 volts primary, 460 volts secondary, 3 phase, 60 cycle, and each having a liquid filled disconnect switch.

3—G. E., type AL-2, 1600 amp., 50000 amp. RMS, Air Circuit Breakers.

12—G. E., type AE1B, 600 amp. Air Circuit Breakers of draw out type.

Switchgear latest type metal clad.

D. C. GENERATORS

125 Volts

KW	RPM	Description
500	750	GE-MCF
300	1500	GE-CC
200	900	GE-MDC
200	800	GE-DMC
100	1000	WE-DLC
100	900	C-W-CCD
80	400	J. & L.-G
65	1100	W-E, type ELC-7
55	1000	GE-Type TD
35	1165	GE-DLC
31.25	1400	Westgh.-SK-single bearing

D. C. GENERATORS

230 Volts

KW	RPM	Description
400	1200	Westgh.
200	1200	GE-MPC
200	575	J. & L.-type K
175	450	Westgh.
125	1400	Westgh.-SK-130L
80	1050	GE-DLC
75	700	Allis-Chalmers-E180
50	1200	Al. Ch.-E-127
35	1800	GE-RC
30	900	Electro Dynamic-158
30	300	Triumph
22½	765	Westgh.-SK
18	300	Burke
15	350	Westgh.-SK

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AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

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PHONE MA. 3024
CINCINNATI 3, OHIO

"BREW, WOLTMAN OFFERS"

TURBINE UNITS

1—9375 KVA Cond. 50 cy. 13800 V. 800-lb. 825 deg. FTT. With surface condenser & boiler. NEW.
1—5000 KVA G. E. Non-C. 60 cy. 13200 V. 600-lb.
1—3750 KVA West. Cond. 60 cy. 2300 V. 200-lb.
1—3125 KVA G. E. Cond. 60 cy. 2300 V. 200-lb.
1—2500 KVA G. E. Cond. 60 Cy. 2300 V. 200-lb.
1—1563 KVA G. E. Extraction 60 cy. 2300 V. 400-lb. extraction 150-lb. Cond.
1—1563 KVA Al. Ch. Cond. 60 cy. 600 V. 200-lb.
1—1250 KVA DeLaval Non-C. 60 cy. 2300 V. 250-lb.
1—1250 KVA Allis Cond. 60 cy. 2300 V. 200-lb.
1—1250 KVA West. Non-C. 60 cy. 2300 V. 275-lb.
1— 937 KVA G. E. Cond. extraction 60 cy. 480 V. 375-lb.
2— 625 KVA G. E. Cond. extraction 60 cy. 480 V. 375-lb.
1— 625 KVA G. E. Non-C. 60 cy. 240 V. 175-lb.
1— 600 KVA Allis Cond. 60 cy. 480 V. 150-lb.
1— 200 KVA Kerr West. Non-C. 60 cy. 220 V. 130-lb.
1—37½ KVA Werhington Non-C. 60 cy. 120/208 V. 75—250-lb.

BOILERS

2—600 HP B. & W. 350-lb. Sectional header.
2—200 HP Erie Economic 125-lb. Stokers.
2—508 HP Casey Hedges Bent tube.
1—507 HP Comb. Engr. 400-lb. 620 deg. TT. Oil.
2—200 HP Erie Economic 125-lb. Stokers.
1—180 HP Frost 200-lb. return tubular.

STEAM ENGINE UNITS—60 Cy.

1—1125 KVA Nordberg Uniflow, 480 V.
1— 450 KVA Ames Uniflow, 2300 V.
1— 400 KVA Skinner Uniflow, 480 V.
1— 312 KVA Skinner Uniflow
1— 150 KVA Ames Uniflow, 220 V.
1— 125 KVA Ames Uniflow, 2300 V.

D.C. STEAM ENGINE UNITS

2—750 KW Skinner Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—275 KW Ames Vertical Uniflow 250 V.
2—200 KW Skinner Uniflow 250 V.
1—200 KW Skinner Uniflow 125 V.
1—100 KW Skinner Uniflow 230 V. 3-wire
1— 75 KW Ames Vertical 125 V.

DIESEL ENGINE UNITS

2—1600 HP Fair. Morse 60 cy. 2300 V. NEW gen.
1— 720 HP Amer. Loco. 240 V. DC
1— 625 HP Worth. 240 V. 60 cy. gen.
1— 600 HP Fair. Morse 2400 V. 60 cy.
1— 400 HP DeLaVergne 2400 V. 60 cy.
1— 375 HP Worth. 240 V. 60 cy. gen.
2— 240 HP Fair. Morse 2400 V. 60 cy.
1— 150 HP Gen. Motors 3-378A-60-3-480
2— 135 HP Murphy 240 V. 60 cy.

SYNCHRONOUS MOTORS—60 Cy.

2—3000 HP G. E. 2300 V. 257 RPM
1—1400 HP G. E. 4150 V. 514 RPM
1— 800 HP G. E. 6600 V. 514 RPM
1— 600 HP G. E. 440V. 360 RPM
2— 500 HP E. M. 2200 V. 514 RPM
3— 400 HP E. M. 440 V. 600 RPM
1— 350 HP G. E. 4800 V. 225 RPM
1— 300 HP G. E. 2300 V. 600 RPM
1— 300 HP West. 2300 V. 900 RPM
1— 250 HP West. 600 V. 180 RPM
1— 250 HP G. E. 550 V. 480 RPM
1— 200 HP G. E. 220 V. 600 RPM
1— 100 HP G. E. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.

1—6000 HP Cr. Wh. S/R 2200 V. 893 RPM
1—7200 HP S/R 11800 V. 750 RPM 25 cy.
1—1200 HP Al. Ch. S/R 2200 v. 440 RPM
1—1000 HP G. E. S/R 2200 V. 514 RPM
1— 600 HP West. S/C 4150 V. 1200 RPM
1— 300 HP West. S/R 2200 V. 1770 RPM
1— 250 HP G. E. S/R 2200 V. 1800 RPM
3— 200 HP E. M. S/C 480 V. 1800 RPM
1— 200 HP Cr. Wh. S/C 2300 V. 720 RPM. New.
1— 200 HP G. E. S/R 2200 V. 435 RPM
1— 150 HP Cr. Wh. S/C 440 V. 1800 RPM
1— 150 HP Cr. Wh. S/C 440 V. 1200 RPM
1— 150 HP Cr. Wh. S/C 440 V. 900 RPM. New.

MOTOR GENERATOR SETS

1—1500 KW Al. Ch. 600 V. DC 60 cy.
1—1200 KW G. E. 125/250 V. DC 60 cy.
2—1000 KW G. E. 600 V. DC 60 cy.
1—1000 KW West. 250 V. DC 60 cy.
1— 500 KW G. E. 250 V. DC 60 cy.
1— 200 KW G. E. 60 V. DC 60 cy.
1— 75 KW West. 125 V. DC 60 cy.
1— 75 KW Ridgway 115 V. DC 60 cy.
1— 75 KW Star 240 V. DC 60 cy.
1— 18 KW West. 60 V. DC 60 cy.

ROTARIES—60 Cy.

1—2929/3705 KW Gen. Elec. 225/285 V.
1—2025/2565 KW Gen. Elec. 225/285 V.
1—2000 KW Allis Chalmers 600 V.
1—1500 KW Westinghouse 600 V.
2—1500 KW Westinghouse 270 V.
2—1000 KW General Electric 600 V.
1— 750 KW Westinghouse 275 V.
1— 500 KW Allis Chalmers 600 V.
1— 500 KW General Electric 275 V.
1— 500 KW Westinghouse 250 V. 3-wire

FREQUENCY CHANGERS

1—12500 KVA G. E. 25/60 cy. 300 RPM
1— 6250 KVA G. E. 50/60 cy. 600 RPM
2— 3000 KVA West. 25/60 cy. 300 RPM
1— 2500 KVA G. E. 25/60 cy. 300 RPM
2— 1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS—60 Cy.

1—1000 KVA West. 66000-11000 V.
4—7500 KVA Al. Ch. 33000-13800 V. 3 ph.
3— 867 KVA Pitts. 33000-11000 V.
1— 200 KVA West. 33000-2400 V.
3— 50 KVA G. E. 33000-2300 V.
6— 75 KVA Moloney 33000-2300/6900 V.
3—3750 KVA West. 26400/13200-2400 V.
1—8000 KVA Penn Auto 26400-13200-2400 V. 3 ph.
4— 450 KVA Al. Ch. 25410/44000-13200/23000 Y
3—1667 KVA Wagner 23000-575/2300 V. 25 cy.
6— 250 KVA West. 22000-2300/4150 V.
2—4000 KVA Penn Furnace 22000-228 V. 3 ph.
6—3000 KVA Al. Ch. Furnace 13200-200 V.
2— 200 KVA G. E. 11500-220/110 V.
3— 200 KVA Moloney 11000-2300 V.
3— 167 KVA G. E. 7200/12400 Y—240/480 V.
1—1500 KVA West. Auto 4000-2300 V. 3 ph.
1— 100 KVA G. E. 2300-575 V. 3 ph.
3— 250 KVA Al. Ch. 2300-460 V.
3— 20 KVA West. 2200-575/287½ V.
3— 7½ KVA G. E. 600-120/240 V.
12— 15 KVA Standard 450-117 Delta
2—27½ KVA G. E. 440-220/110 V.

OIL CIRCUIT BREAKERS

2— 800 A. 87 KV Am. Brown Boy. Outdoor
1— 400 A. 37 KV West. GII Outdoor
2—1000 A. 230 KV Kelman CB 76 Outdoor
4— 600 A. 15 KV G.E. FHK013BBS Outdoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

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TRANSFORMERS

The following 3 transformers were used in one bank

1—333 KVA. Gen. Elec., 33000 x 13200/6600
2—500 KVA. Pittsburgh 330 x 13200/6600
3—400 KVA Westgh. 13200 x 240
2—200 KVA. Packard 2300 x 115/230
2—150 KVA. Pittsburgh 2300 x 230/460
2—150 KVA. Pittsburgh 2300 x 115/230
4—100 KVA. Gen. Elec. 2300 x 115/230
Other sizes in stock in various voltages.

TURBO GENERATORS

1—500 KW., 3 ph., 80 cy., 440 volt to Gen. Elec. turbine #339937. With condenser switchboard etc. Very modern unit.
1—500 KW., 3 ph., 60 cy. Gen. Elec. non condensing.
1—750 KW., Gen. Elec. automatic extraction.

MOTOR GENERATORS

1—105 KW., 1500 amp., 70 volt to 150 HP., 3 ph., 220/440 volt, 1165 RPM. ball bearing Electric Products Co. set.
1—1000 amp., 80 volt Burke with 3 ph. syn. motor.

MOTOR GENERATORS (Cont'd)

1—75 KW., 250 volt, 1200 RPM., 3 ph., 60 cy., 440 volt syn. motor, Star Electric Co.
1—50 KW., 250 v., Louis Allis to 75 HP., 220/440 volt type I-K Gen. Elec.
1—15 KW., 250 v. Westgh. SK to 3 ph., type CS motor.

CAPACITORS

8—180 KVA, Westinghouse, Interteen, 3 phase, 60 cycle, 460 volt.
6—120 KVA, Westinghouse, Interteen, 3 phase, 60 cycle, 460 volt.
11— 90 KVA, Westinghouse, Interteen, 3 phase, 60 cycle, 460 volt.
3— 90 KVA, General Electric, Pyranol, 3 phase, 60 cycle, 460 volt.

MISCELLANEOUS

2—25 KVA., 1 ph., 60 cy., 120 or 240 v. Westgh. to 4 cylinder LeNel engines, with panels.
1—150 KW., 125 volt Crocker Wheeler generator to 4 cylinder vertical Ames steam engine.
1—1000 HP., Gen. Motors Diesel Engine to 600 KW., 500 volt, 750 RPM. Westgh. generator.

Send for our catalogue of A.C. & D.C. motors, A.C. & D.C. Generators, transformers, starters, and other related equipment.

KEYSTONE POWER PLANT EQUIPMENT CO.

8403 HEGERMAN STREET HOLMESBURG, PHILADELPHIA 36, PA.

MODERN EQUIPMENT

65 ton Whitcomb diesel elec. locomotive.
30 ton Plymouth gasoline locomotive.
2200 ft. Chicago Pneu. Compressor. New 1942.
25 ton Steel Stiffleg Derrick and Hoist.
2-450 HP Fairbanks Morse 300 KW diesel engine generator sets.
2500 KW General Electric 2300 volt condensing turbine generator set.
2-500 HP B&W 250 lb. Watertube Boilers.

Many other items of Power, Railroad and Industrial equipment.

MISSISSIPPI VALLEY EQUIPMENT CO.

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COMPRESSORS—VACUUM PUMPS

NEW and GUARANTEED REBUILTS

SPECIALS

7/3⅛x7 Chicago T-CB 105 CFM 350 LBS
22x9 Ingersoll Rand, ES Vacuum Pump 1183 CFM
9/4x9 Ingersoll Rand, ES2, 191 CFM 350 LBS
9-10 x 9 Ingersoll Rand, FS1, 242 CFM 75 LBS
10x9 Ingersoll Rand, ES1, 262 CFM 75 LBS

Any Make—Any Size—We Can Help You, Portable or Stationary

American Air Compressor Corp.

Dell Ave. and 47th St., North Bergen, N. J.

NEW MOTORS AND CONTROLS AT REDUCED PRICES!

SLIP RING
220/440 VOLT

Qu.	HP	SPEED	MFG
1	100	720	ELLIOTT
2	125	720	ELLIOTT
1	150	720	ELLIOTT
2	500	1200	ELLIOTT

NEW C-H CONTROLS FOR EACH OF ABOVE

SQUIRREL CAGE
220/440 VOLT

Qu.	HP	SPEED	MFG
2	60	1200	A-C TEFC
2	75	1800	A-C TEFC
*1	125	600	E-M BALL
*1	350	900	WHSE-CS

* 2300 Volt.

D. C. MOTORS
230 VOLT

Qu.	HP	SPEED	MFG
6	5	1750	REL 23-T
3	10	1750	REL 34-T
1	15	300/1200	L-A
5	35	850	REL 230-T
6	75	1750	F-M DX

RECONDITIONED AND GUARANTEED

SLIP RING

Qu.	HP	RPM	MFG	VOLTS
1	40	1200	A-C	440
1	100	1800	A-C	440
1	100	600	G.E.	440
1	250	600	WHSE	2300
2	350	450	WHSE	2300
1	600	514	C-W	440

SQUIRREL CAGE

Qu.	HP	RPM	MFG	VOLTS
10	20	1800	REL	220/440
2	50	900	G.E.	220/440
1	75	1200	IMP.	440
1	75	1800	IDEAL	2300
1	125	600	WHSE	2300
1	150	720	WHSE	4160
1	300	720	A-C	440

D. C. MOTORS 230 V

Qu.	HP	RPM	MFG	
3	15	400/1600	REL	BALL
2	40	500/1500	C-W	BALL
1	50	300/1200	REL	PLANER
1	60	300/1200	G.E.	RF-17
2	75	500/1500	C-W	BALL
2	125	400/1200	REL	1050-T
1	250	275/690	G.E.	RF

SYNCHRONOUS

Qu.	HP	RPM	MFG	VOLTS
1	200	720	G.E.	440
1	225	450	E-M	2300
2	250	360	G.E.	2300
1	300	514	E-M	440
1	350	200	WHSE	2300
1	600	450	G.E.	2300

M-G SETS

Qu.	KW	D.C.	MFG	A.C.
21	5	250	REL	440
15	3	250	REL	220
1	100	250	G.E.	2300
1	300	250	C-W	2300
1	300	600	G.E.	2300
1	500	600	G.E.	4160

REDUCERS—NEW

Qu.	MFG	HP	TYPE	RATIO
6	FALK	5	28DU	10:1
2	FALK	10	34DU	10:1
1	ABART	12	6A	18.5:1
2	FOOTE	15	60DX	10:1
1	AM.ENG.	50		16:1

MAGNETIC SLIP RING CONTROLS—NEW

15 — 250 HP 440 V. ALLIS, REVERSING, STARTING OR REGULATING DUTY WITH 600A. AIR CKT BRKR.

CONTROLS

WE CAN BUILD ALL TYPES OF A.C. AND D.C. CONTROLS, MAGNETIC OR MANUAL — TO YOUR SPECIFICATIONS.

HYDRAULIC PUMP 250 GPM 1500 LBS.

BETHLEHEM HORIZONTAL TRIPLEX WITH 440 OR 2300 VOLT MOTOR AND MAGNETIC STARTER — EXCELLENT.

The Boswick Electric Co.

P. O. BOX 55, AKRON 9, OHIO • Phone WAlbridge 1195

Buy from Boswick with confidence!

POWER PLANT MACHINERY

Actual Photograph

500 KVA SKINNER UNIFLOW ENGINE GENERATOR UNIT

500 KVA General Electric Generator, 3 phase, 60 cycle, 460/230 volts, 120 RPM, direct connected to Skinner Universal uniflow engine, 130-160# steam pressure, 0-5# back pressure. Excellent condition, can be shown in operation.

TURBO GENERATORS
3 phase 60 cycle

5000 KVA G.E., 13800 volts, 600# steam, 135# extraction, 25# exhaust.

1875 KVA Westg., 480 volts, 200# steam, 15# back pressure.

937 KVA Allis Chalmers-Kerr, 480 volts, 150# steam, 5# extraction.

375 KVA Allis Chalmers-Kerr, 220 volts, 125# steam, 25# back pressure.

250 KVA (2) G.E., 480 volts, 150# steam, 5# back pressure.

UNIFLOW UNITS
3 phase 60 cycle

500 KVA Skinner, 460/230 volts, 130-160# steam, 0-5# exhaust.

250 KVA (2) Skinner, 460/230 volts, 110-175# steam, 0-5# exhaust.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

TURBO GENERATORS

TURBINE OF THE MONTH

1—750 KW General Electric 250/265 lbs. I.S.P., Condensing, Type FN3, Serial No. 61707 generator, 3 ph., 60 cycle, 440 v. with direct connected exciter. Equipment built 1944.

1—2000 KW G.E. 6600v, 3 ph., 60 cy. with 175 lb. cond. turbine and dir. conn. exciter.

1—1000 KW Westg. 400#, 700°F, condensing 3 ph, 60 cy. 2400 V. Surface condenser.

1—450 KW Whse 250 lbs. I.S.P. Surface Condensers—Auxiliaries—3 phase, 60 Cycle, 400 Volts. Direct connected Exciter Equipment built 1944.

2—1250 KW G.E. 2300v, 3 ph. 60 cy. with 175 lbs. condensing turbine

1—1250 KW Al Ch. 2300v, 3 ph., 60 cy. with 200 lb. condensing turbine surface condenser.

1—1000 KW G.E. 2300/4150v, 3 ph., 60 cy. with 135/150 lb. condensing turbine.

1—500 KW G.E. 480v, 3 ph., 60 cy. dir. conn. exciter with 80/100 lbs. I.S.P. 10/15 lbs. B.P., non-condensing turbine.

1—500 KW G.E. 2400 v, 3 ph., 60 cy. dir. conn. exciter, 175 lbs. I.S.P. 10/15 lbs. B.P. non-cond.

BELYEA COMPANY INC.

43 HOWELL ST. JERSEY CITY 6, N. J.

Phone—Journal Square 2-3334

ALSO N. Y. CITY LINE—RECTOR 2-7150

FOR SALE

2—1800 HP Fairbanks-Morse, Model 38D 8⅛, 8⅛"x10", 800 RPM, 10 cylinder, air start, solid injection, complete with auxiliaries. Excellent Condition.

New 450 HP Enterprise Diesel engine, Model DSG-6, 6 cyl., 4 cycle, 450 RPM, air start, solid injection.

3—Allis Chalmers 1000 gal. per min. 6x5 Centrifugal pumps, driven by Hercules Diesel engines, 6 cylinder, Model DWXDS, 1800 RPM. Rebuilt.

ALJOHN DIESEL CO., INC.

904 Pacific St., Brooklyn 16, N. Y.

STerling 3-6515

TURBO GENERATORS FOR SALE

6000 KVA Condensing, 2400 v, 225 lbs. Complete

1250 KVA Condensing, 2300 v, 200-300 lbs. Also others.

STEPHEN A. DOUGLASS CO.

630 Fort Washington Ave., New York 33, N. Y.

ASME BOILERS Nat'l Bd.

2—104 HP sectional steel header cross drum Springfield, 10' settings, oil fired.

2—25,000# (normal rating) Stirling's pulverizers, 425#.

2—400 HP sectional header, underfeed stokers.

1—360 12' settings, 7 years old, stack & breeching for these 3 units.

H. P. BREARLEY

3423-91st Street Jackson Heights, N. Y.

MOTORS • GENERATORS TRANSFORMERS

25 cy. 60 cy. D.C.

ALL VOLTAGES 1-1500 H.P.

NEW and REBUILT BOUGHT and SOLD

ELECTRIC EQUIPMENT CO.

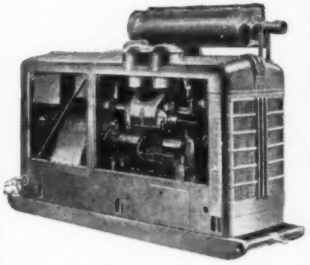
ROCHESTER 1, N. Y.

NEW

60 KW GMC DIESEL SETS

for

IMMEDIATE DELIVERY



These fully-portable, self-contained units are offered at considerably less than manufacturer's list prices.

WRITE OR WIRE TODAY
FOR COMPLETE INFORMATION

OTHER NEW UNITS AVAILABLE
FROM 10 KW TO 50 KW

A. G. SCHOONMAKER CO., INC.
52 Church St., New York 7, N. Y.

MOTOR GENERATORS

500 KW G. E. Syn. 600 V. DC. 900 RPM. 440/2300/4000/6900 V. AC. 3 P., 60 C.

400 KW West. Syn. 600 V. DC. 720 RPM. 2300/4000 V. AC. 3 P., 60 C.

300 KW G. E. Syn. 250 V. DC. 1200 RPM. 2300/4600 V. AC. 3 P., 60 C.

300 KW Rdwy. Syn. 250 V. DC. 1200 RPM. 2300/4000 V. AC. 3 P., 60 C.

150 KW G. E. Syn. 250 V. DC. 1200 RPM. 2300/4000 V. AC. 3 P., 60 C.

•

SYNCH. CONVERTER

300 KW G. E. 600 V. 6 P., 60 C., 1200 RPM. 2300/4000/6900/13,200 V. Trans.

WALLACE E. KIRK COMPANY
502 Grant Building, Pittsburgh, Pa.

MODERN DIESEL GENERATING PLANTS

450 HP Fairbanks-Morse Diesel Engine, 6 cylinder, series 32-E-14, 300 RPM, direct connected to 300 KW Fairbanks-Morse generator, 240 volt, 3 phase, 60 cycle.

300 HP Fairbanks-Morse Diesel Engine, 4 cylinder, series 32-E-14, 300 RPM, direct connected to 200 KW Fairbanks-Morse generator, 240 volt, 3 phase, 60 cycle.

30 KW Ready-Power Portable generator sets.

DENNY & CLARK
1923 W. North Ave., Chicago 22, Ill.

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

PROMPT SHIPMENT—PARTIAL LISTING

SLIP RING MOTORS—3 Ph., 60 Cy.

Qu.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
1	7½	575	220	G.E.	MT-522
2	10	1140	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	810	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	18	680	440	West.	NW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	1130	440	G.E.	MT-326
1	30	865	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	600	440	F-M	HV-H16A
2	40	865	2200	Al-Cb.	ARY-223C
1	40	560	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	869	440	West.	HF-12A
1	50	570	440	G.E.	MT-552
5	52‡	550	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	45	550	West.	CW
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	505	550	West.	CW-1002
1	200	1760	2300	G.E.	IM-E13B
2	200	600	550	G.E.	IM-E
1	200	495	2200	G.E.	IM-17A
3	300	900	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
2	350	680	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	600	1770	440	G.E.	IM-E15L
1	650**	360	440	G.E.	MT-442Y
1	700	735	4000‡‡	West.	CW

All 220 volt motors can be reconnected for 440 volts.
‡ Intermittent rating. *** 2 phase.
** New. †† 50 Cycle. ‡‡ 25 Cycle.

230 Volt Constant Speed D.C. Motors

Qu.	H.P.	Speed	Make	Type
22	2	850	West.	SK-20
20	3	1150	West.	SK-20
10	3	850	Reliance	Y-23T
25	3½	850	West.	SK-30
2	7½	1150	G.E.	CDM-66
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al-Cb.	EB-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
5	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-1101
17	25	825	West.	SK-120
2	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	690	G.E.	RC-16
1	60	1750/1310	West.	SK-143
1	150	700	Al.-Cb.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D.C. MOTORS

10	1½	500/200	G.E.	CD-65
1	2	225/900	Reliance	78T
1	5	450/1800	G.E.	CD-83
2	6	450/1800	G.E.	RF-9
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
2	10	600/2400	Reliance	T-92T
1	12½	250/840	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	400/1600	Reliance	T-230-T
1	20/25	300/1200	West.	SK-153
1	25	400/1800	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1600	Al.-Cb.	ED-147
1	75	500/1500	Cr.-Wh.	CCM
1	75	375/750	Cr.-Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Cb.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/800	West.	SK-220
2	375	350/500	G.E.	MPC

** New.

VARIABLE VOLTAGE DRIVES

40 HP, Reliance, Variable Voltage Drives, each Consisting of:
1—40 KW 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing jog forward, jog reverse, run, fast, slow, and stop, and motor operated field rheostat.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

Qu.	H.P.	RPM	Volts	Make	Type & Frame
2	½	1750	220	R&M (TE)	L-184
1	½	1725	440	G.E.	K-63
4	1	1140	220	Howell	A-204
4	1.5	1150	220	L.A. (TE)	IS-225
5	1.5	1140	440	West.	CS-225
1	2	1735	220	G.E.	K-224
4	2	1140	220	L.A.	Js-225Y
2	3	1160	440	L.A.	JS-254
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-EXPF
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1760	220	G.E.	K 365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504

Splashproof, Ball Bearing

1	2	1735	440	G.E.	K-224
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-284
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	10	3493	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	125	1770	440	L.A.	FX-1078Y
1	150	1775	440	L.A.	FX-1108
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335
1	200	885	440	L.A.	FS-1378

Open Type Motors

Qu.	H.P.	Speed	Volts	Make	Type
5	2	170	440	G.E.	KT-926
4	2	1160	440	West.	CS-93C
1	2	690	440	G.E.	KT-944
10	5	1740	440	West.	CS-232C
1	7½	3475	440	West.	CS
1	7½	1750	440	West.	CS-250C
3	7½	1165	440	G.E.	KT-952
2	7½	870	440	West.	CS-370C
5	10**	1760	440	L.A.	OGA-324
5	10**	1750	440	West.	CSP-324
3	10	1160	440	West.	CS-370C
1	10	865	440	G.E.	KT-502
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RP1-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-556***
2	25**	875	440	Master	FR-405
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-580C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-662C
1	75	870	220	West.	CS-766A
2	75	885	2300	G.E.	KT-352
1	100	690	220	West.	C
1	100	580	2200	G.E.	JK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Cb.	AN
2	125	435	440	Al.-Cb.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	580	550‡‡	G.E.	KT-5666
1	300	1200	440	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

All 220 volt motors can be reconnected for 440 volts.
** New. *** 2 Phase.
‡‡ Reconnectable for 440 volts.

CRANE, MILL TYPE, 230 V. D.C. MOTORS

Qu.	H.P.	Speed	Make	Type
2 (115 v.)	3½	700	G.E.	CO-1803
2	5½	760	West.	MCB-20
2	9.5	750	G.E.	MDS-404AE
1 (new)	10	650	G.E.	MDS403-BE
1	23	600	G.E.	MDS400
3	25	590	Diehl	TE
2	27½	535	West.	K-7
2	35	750	G.E.	CO-1828
3 (new)	35	600	West.	CK-9
1	50	750	G.E.	CO-1829A
1	50	600	West.	CK-9
1	50	525	G.E.	CO-1830
1	50	470	G.E.	CO-2007
2 (new)	60	550	G.E.	COM-1831 AE

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment Is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVE. CLEVELAND 14, OHIO

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220/440 VOLTS

H.P.	Make	Type	Frame	RPM
50	Fairbanks Morse	H16B	Ball Bearing	750
75	Fairbanks Morse	H16C	B.B. Slipring	750
75	Gen. Elect.	IK	2300 volt	750
75	Gen. Elect.	IK		1500
100	Allis Chalmers			1450
150	Gen. Elect.	IK-17		365
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	IM-16	Slip Ring	480
150	Allis Chalmers			1450
150	Gen. Elect.	KT	557	1455
400	Gen. Elect.	IM 17A	Slip Ring	720
500	Gen. Elect.	IK		485
600	Gen. Elect.	MT	Slip Ring	490
600	Westinghouse	C8		490

MOTOR GENERATOR SETS

2—350 KW General Electric Sets 250 Volts D.C. driven by 500 HP, 3 Phase 25 Cycle motors
—Will rewind for 60 Cycle operation.

3000 CYCLE MOTOR GENERATOR SET

GENERATOR—175 KVA General Electric A.C. Generator, type A.S.C. form AL, single phase, 300 volts, 3000 cycle, 1800 RPM, serial #3513629.

GENERATOR EXCITER—1 KW, General Electric Generator, type KF, form KB, 125 volts, D.C., 1800 RPM, 8 amps., serial #1758709.

MOTOR—300 HP, General Electric synchronous motor, type TS, form KL, .8 P.F., 3 phase, 60 cycle, 440 volts, 1800 RPM, serial #5513638.

MOTOR EXCITER—3 KW, General Electric Generator, type KF, form KB, 125 volts, DC, 1800 RPM, 24 amps., serial #1758730.

Motor and Generator are direct connected, 4 bearing. Mounted on factory fabricated base, with direct connected exciters.

3000 Cycle Control is mounted in cubicle also containing 300 HP General Electric synchronous motor starting control.

FREQUENCY CHANGERS

All Sizes in Stock, 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 and any other high cycle if desired.

HORIZONTAL & DUPLEX
Compressor & Vacuum Pumps after Coolers, Filters

25 CYCLE MOTORS

1—1270 HP, Gen. Elect. Synchronous Motor Type A T.I. 3/25/2200 Volts 150 RPM.
1—1900 HP, Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.

NEW TRANSFORMERS

3—25 KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps
3—37½ KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps.
6—50 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—75 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—100 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—100 KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps.
3—150 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—200 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—250 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—333 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.

REBUILT TRANSFORMERS

Qu.	KVA	Make	Cycle	Voltage
3	50	Pitts.	25	11000/2300
2	50	Kuhlman	25	11500/2300/230/460
1	50	Kuhlman	25	11500/115/230
2	50	G. E.	60	2400/120/2400
1	100	G. E.	25	4600/230/460
3	400	Pitts.	25	12000/110

NEW MOTORS

300 New Gen. Elect. & Westinghouse Motors in stock from 1 to 100 H.P.

100 KVA TRANSFORMERS

3—100 KVA Gen. Elect. Transformers, Type H Form KF—2400/4160 volts primary 120/240 volts secondary. Price $450.00 each. Electrically O. K. F.O.B. truck, Minnesota.

MOTORS

1—75 HP, Fynn-Weichel Synn. 3/60/440/1200 RPM.
1—100 Gen. Elect. Slipring Type I Form M., 3/60/440/900 RPM.
1—100 HP, Gen. Elect. Type K (New Motor) 3/60/440/1800 RPM.
1—100 HP, Westinghouse Slipring Type CW, 3/60/440/435 RPM.
1—100 HP, West. Slipring Type CW 3/60/440/1200 RPM.
1—100 HP, Gen. Elect. Slipring 3/60/440/1200 RPM.
1—200 Gen. Elect. Type KT. 572 3/60/440/600 RPM.
1—200 HP, Gen. Elect. Slipring Type I Form M. 3/25/440/500 RPM.
1—500 HP, Allis Ch. Slipring 3/60/2200/514 RPM.
1—500 HP, Gen. Elect. Type I Form K. 3/25/440/485 RPM.
1—600 HP, West. Motor Type CS, 3/25/550/490 RPM.
1—600 HP, Gen. Elect. Slipring Type MT, 3/25/550/490 RPM.

VARIABLE SPEED MOTORS

2—300/150 HP, General Electric Motors Type BTA.—3 Phase 60 cycle 440 volts 560/280 RPM with controls.

3 PHASE 550 VOLTS 25 CYCLE MOTORS

Write for our stock list of approximately 500—3/25/550 Voltmotors

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

POWER PLANT EQUIPMENT

Special Offerings

TURBO-GENERATORS

2—New 4000 KW Cond. 2400/4160 V. 750° T.T.
1—3500 KW 2300 V Cond.
1—2500 KW 600 V Cond.
1—2500 KW 2300 V Cond.
1—3000 KW 600 V Cond.
1—2000 KW 600 V Cond.
1—1500 KW 2300 V Cond.
2—1250 KW 2300 V Cond.
1—1000 KW 2300 V Non-C.
2—1000 KW 440 V Cond.
1— 625 KW 2300 V Cond.
1— 600 KW 240 V Cond.
1— 500 KW 600 V Cond.
1— 500 KW 240 V Non C.
1— 500 KW 480 V Extrac.
1— 350 KW 2300 V Non-C.

TURBO-GENERATORS (Continued)

1— 250 KW 240 V Non-C.
1— 150 KW 2300 V Non-C.
1— 125 KW 600 V Extrac.
1— 100 KW 600 V Non-C.
1— 50 KW 220 V Non-C.

DIESEL GENERATOR

1—New 1000 KW — 2400/4160 V.

DEAERATING HEATER

1—New 250,000# pr Hr. 30#

BOILER FEED PUMP

2—New 500 GPM Cent. 1200# 1 with motor—1 without.

MOTOR

1—New 400 HP 900 RPM —2300 V.

BOILERS

2—30,000# 425#
1—15,000# 700#
1— 500 HP 400#
1— 300 HP 200#
1— 220 HP 160#
1— 200 HP 175#
6— 200 HP Sterling 160#
2— 190 HP 160# NEW
2— 510 HP Sterling 160#

AIR COMPRESSORS

1—6000 CFM 50# Motor
2—5600 CFM 50# Motor
1—4500 CFM 100# Motor
1—1300 CFM 100# Motor
1—6000 CFM 5.1# NEW
1—5000 CFM 10# Rotary Type Motor

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1—4000 KVA Westinghouse 2400 V surf. cond.
1—3750 KVA G.E. 480 V. cond.
1—2500 KVA Allis-Chalmers 2300 V cond.
1—1250 KVA G.E. 480 V mixed pressure

ENGINE GENERATORS

2—675 KVA Skinner Unaflow—direct connected to Westinghouse 240/480 V gen.
1—675 KVA Allis-Chalmers full releasing Corliss 480 V
1—375 KVA Ames vertical 220/440 V
1—275 KVA Ridgeway N.R.C. 2300 V
1—187 KVA Ames vertical
1—156 KVA Ames vertical 240 V

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1—250 KVA G.M. 220/440 V 3 phase 60 cycle "twin" 6-71 diesel engine generating unit. New—not War Surplus.
1— 75 KVA Buda 240 V 3 phase 60 cycle generating unit. New—not War Surplus.
Also General Motors, Fulton, Fairbanks and Nordberg engines from 15 to 1500 KW.

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Large stock of Transformers, Motors, M.G. Sets, and Generators

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Mutual 9151

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12— 5 KVA W-H 13200-120/240
4— 10 KVA W-H 13200-120/240
3— 25 KVA W-H 13200-120/240
3— 25 KVA Mol 13200-120/240
10—37½ KVA W-H 13200-120/240
2— 25 KVA W-H 13200-2400
2—37½ KVA Mol 13200-2400/4160Y
3— 75 KVA W-H 13200-120/240
3— 75 KVA G-E 13200-120/240
1— 75 KVA Mol 13200-2400
1— 100 KVA W-H 13200-2400
10— 1½ KVA Wag 7200-120/240 "REA"
4— 5 KVA W-H 2400/4800-120/240
4— 7½ KVA W-H 4800/8320Y-120/240
3— 50 KVA W-H 4800/8320Y-120/240
3— 50 KVA G-E 26400-2300/4000Y
3— 50 KVA G-E 33000-2400/4160Y
3— 100 KVA G-E 33000-2400/4160Y
1—Gas Fired Recirculating Young Bros. DRYING OVEN, 2 Compts. complete with controls.

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3—375 KVA 60 cy 3 ph 440 volts Elliott Alternators Direct-connected to Ingersoll-Rand 400 RPM Gas engines—complete with exciters & switchboards. Can be rewound for 2300 volts. Running and in operation at this time.

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300 SOUTHWEST BLVD.
KANSAS CITY 8, MISSOURI

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2—2100 HP, GE Synchronous motors, 514 RPM, 4600/2300 V, 3 phase, 60 cycle, 80% P.F. Complete with rheostats and belted exciters. Full details on application.
2—2000 KVA Transformers—Single phase 60 cycle, 69/34.5 KV to 4800/2400 V. Westinghouse O.I.S.C.
1—3500 KVA—3 phase, 60 cycle, 33/13.8 KV Westinghouse Transformer.
1—600 A., 3 P.S.T., 34.5 KV Outdoor O.C.B. Westinghouse CO-1-A.
1—3 pole, 600 A, 34.5 KV Outdoor Disconnect Switch.
Miscellaneous Distribution Transformers, Cable, Switches, Potheads and Electrical Instruments. Also Ross Carrier—hardly used. Arch measurements—91" high and 76" wide. 7 Ton capacity.
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ELECTRICAL POWER EQUIPMENT

CHECK THIS PARTIAL STOCK LISTING FOR

REAL VALUES IN REBUILT D.C. MOTORS

D. C. MOTORS - - 230 VOLT

H.P.	Make	Type	Speed
350	G.E.	C.D.	1200
200	G.E.	C.D.M.	1750
100	G.E.	R.C.-34	2500
80	Westg.	S.K.	450
75	Westg.	S.K.-160	850
60	Westg.	S.K.	1200
60	G.E.	C.D. (550 V)	1000
45	Westg.	S.	650
40	G.E.	CO-2004	600
35	Cr. Wh.	C.M.	840
35	Roth	FR-40S	850
35	Cr. Wh.	CM-351	700
35	Westg.	S.K.-140	675
30	Cr. Wh.	C.C.M.	450
30	Westg.	SK-120	975
30	Al. Ch.	Bullock	575
25	Westg.	B7	850
25	G.E.	CL-6	795
20	Westg.	SK-83	1750
20	G.E.	R.C.	1150
20	G.E.	R.C.	800
15	G.E.	RC-10	1150
15	Westg.	IVC-13	925
15	G.E.	CVC	925
15	Cr. Wh.	C.M.	800
15	G.E.	RC-29	1150
15	Cr. Wh.	BH	1750
10	Star	Sq-20	600
10	Westg.	SK-90	600
10	Westg.	SK-80	730
10	G.E.	RC-11	700
10	G.E.	RC-29	750
10	G.E.	RC-29	850
10	Al. Ch.	E-90	850
10	G.E.	RC-49	900
10	G.E.	CD-73	1100
10	G.E.	CD-75	1150
10	G.E.	RC-29A	1150
10	Westg.	SK-60L	1150
10	Westg.	SK-63	1150
10	G.E.	CD-73	1750
10	Elec. Dy.	D-326	1750
10	Westg.	SK-43	2075
7	Westg.	SK-70L	1050
7½	G.E.	CVC-114	825
7½	Westg.	SK-60	850
7½	Westg.	SK-63	1150
7½	G.E.	CD-73	1150
7½	G.E.	RC-8	1150
7½	Reliance	34T	1175
7½	Westg.	SK-30	1700
7½	G.E.	B-284	1750
7½	G.E.	B-284	1750
5	Westg.	SK	1100
5	G.E.	RC-7	1150

ADJUSTABLE SPEED--D.C.--230 VOLT

H.P.	Make	Type	Speed
500	G.E.	MPC	165/330
250	ELD		400/1200
180/230	G.E.	MPC	730/980

ADJUSTABLE SPEED--D.C.--230 VOLT

H.P.	Make	Type	Speed
175/350	G.E.	MPC	400/800
100	D.C.	Dyn.	2000/3500
75	Westg.	SK	350/450
35	G.E.	C.	300/900
30	Westg.	S.A	400/1200
30	G.E.	SP	240/700
30	Sprague	C-60	240/300
30	Triumph	JF	250/750
25	G.E.	RC-16	500/700
25	G.E.	DLC	600/1000
25	G.E.	RC	500/700
25	Westg.	S-9	560/780
15	G.E.	LC	550/1000
15	G.E.	RC-16	500/700
10	Westg.	SK-100	400/1600
10	G.E.	CD	600/1200
10	G.E.	RF	600/1800
10	Westg.	SK	500/1500
10	Westg.	SK	850/1700
11	Westg.	SK-90	450/1800
10	G.E.	CD-83	600/1800

D. C. MOTORS - - 110 VOLTS

H.P.	Make	Type	Speed
125	G.E.	RC-29A	500
55	G.E.	DLC-203A	1000
25	G.E.	RC-32	800
25	Cr. Wh.	CM-251	750
7½	Reliance	REB	1200
5	Sturv.		570
5	G.E.	RC-7	1150
3	G.E.	BC-23B	3450
3	G.E.	B-224	3500
2	G.E.	CVC-111	1100
2	G.E.	RC-25	1150
2	G.E.		1400
2	G.E.	RC-22	3450
2	G.E.	RC	3450
1½	Diehl	C-305	460
1½	Watson	BW-3	550
1½	Westg.	SK-224	1150
1½	Westg.	CD	1725
1	Diehl	16	475
1	Elec. M.	E	2500

ADJUSTABLE SPEED--D.C.--110 VOLT

H.P.	Make	Type	Speed
60	Sprague	C	500/1500
30	Westg.	E	615/1230
20	Roth		685/1165
10	G.E.	RC	575/1150
10	N.W.		600/1200
4½	Cr. Wh.	CM-1Q1F	580/1740
½	Roth		350/1400

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Carries a complete stock of rebuilt equipment of the following types:

- SQUIRREL CAGE MOTORS
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- SLIPRING MOTORS
- AC and DC GENERATORS
- DIESEL and STEAM GENERATORS
- TRANSFORMERS
- SWITCHBOARDS
- CONTROLS
- HOISTS and CRANES
- COMPRESSORS

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STEAM — ELECTRIC — HYDRO — DIESEL

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1—140,000# New Steam Generator 600#
1—140,000# MODERN Steam Generator 450#
2—60,000# MODERN Boilers 450#
2—40,000# MODERN Boilers 250#
2—30,000# MODERN Steam Generators 450#
2—1040 HP Heine Boilers—Super 200#
2— 825 HP B&W Co. Stirling—Super 200#
2— 600 HP B&W Co. Sectional—Super 200 to 350#
3— 310 HP B&W Co. Stirling 180#
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

1—7,500 KW Turbo-Generator—Cond.
3—5,000 KW Turbo-Generators—Cond.
1—4,000 KW same as above
2—2,500 KW same as above
3—2,000 KW same as above
2—1,500 KW same as above
2—1,250 KW same as above
2—1,000 KW same as above
1— 500 KW same—Also 750 KW & 300 KW Units
Non-Cond:—300 - 500 - 750 - 1000 - 1500 - 2000 - 2700 KW.

COMPLETE STEAM PLANTS: One with 2-1500 KVA's, One of 2500 KVA & One of 7500 KVA.
Frequency Changers—Transformers! Send us your requirements—We may have it.
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Buy direct from one of the largest stocks of Electrical Equipment in the East.

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1—400 KW Motor Generator Synch. Driven 250/120 volts DC
10—1000 & 1500 Amps Multi-Arc Welding Generators AC Motor Driven
2—200 KVA A.C. Generators 600 rpm
1—219 KVA A.C. Generator 257 rpm
4—25 KVA 3 PH Generators Driven by 20 HP DC 1800 rpm 230 Volt, Motors NEW
1—100 HP Electro Dynamic 1800 rpm 230 volt DC Motor
3—150 HP Crocker Wheeler 900 rpm 230 Volt DC BB TEFC Motors
2—250 HP G.E. 3 Ph. 60 Cy. 440 Volt 1800 rpm Motors
1—200 HP G.E. 3 Ph 60 Cy 2300 Volt 257 rpm Synch. Motor
1—450 HP West. 3 Ph 60 Cy 440 Volt 500 rpm Slip-ring Motor
1—300 KW DC 240/120 Volt Diesel Driven Generator
4—100 KW DC 240/120 Volt Diesel Driven Generators

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4000 KW TURBINE GENERATING PLANT

Consisting of

1—2000 KW and 2—1000 KW General Electric, 3 phase, 60 cycle, 480 Volts, 3600 R.P.M. Condensing Turbo Generator Units. Complete with all Auxiliaries. General Electric inspection reports are available.

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¾"	1½"
1"	2"
1¼"	2½"

Prime Stock—T & C or Plain End
Full Mill Lengths—Domestic Pipe—
Standard Specifications

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A. C. GENERATORS 3 PHASE—1 PHASE 15 to 62½ KVA

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D. C. MOTOR GENERATOR SETS TO 75 KW • HIGH CYCLE GENERATORS
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WURTH ELECTRIC MOTOR COMPANY
Motors, Generators, Alternators, Frequency Changers
141 GRAND ST. — CAnal 6-6138 — NEW YORK CITY

HYDRO-ELECTRIC GENERATING MACHINERY

1 GE vertical 144 KW unit 3 phase 60 cycle 240V 120 RPM 3000 lb. Woodward governor Smith turbine 9-13' head.
1 Allis Chalmers 250 KW vertical unit 2300V with adjustable blade turbine and governor for 9-14' head.
1 GE vertical 192 KW 2300 V complete for 10-16' head.
1 GE vertical 225 KW 2300 V complete with gov. and Smith wheel 10-22' head.
1 GE vertical 168 KW 2300 V complete for 10-15' head.
1 GE vertical 80 KW 2300 V complete with Leffel B or Smith wheel for 12-22' head.
2 Leffel scroll wheels for heads from 150-250'.
Many others, both horizontal and vertical types. We are specialists in hydro-electric equipment.

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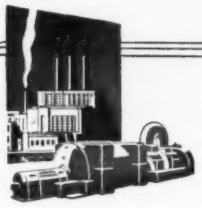

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HEAVY POWER EQUIPMENT

TURBO GENERATORS (ISP: 125# 486° to 600# 750° FTT)

ITEM NO.	QUANTITY & CAPACITY	
51	1250 KW	125# 486° ISP. 600 volt. CONDENSING. All auxiliaries. 1920.
62	300 KW	150# 486° ISP. 120/208 volt. CONDENSING. All auxiliaries. 1927. **Factory rebuilt and rewound 1940.**
432	500 KW	150# 486° ISP. 480 volt. EXTRACTION @ 15#G.
740	1000 KW	150# 486° ISP. 2400 volt. EXTRACTION: 38,000#/hr. @ 10#G. 1927. CONDENSING.
16	1250 KW	200# 486° ISP. 2400 volt. CONDENSING. All auxiliaries. 1924.
1049	2000 KW	175# 486° ISP. 2400 volt. CONDENSING. All auxiliaries. 1918. Entirely overhauled and rebuilt 1940. In all critical and moving parts it shows 5 years' normal wear. Heavy 3rd stage wheel installed. Total log record 8 years.
1887	3000 KW	200# 486° ISP. 2400 volt. CONDENSING. All auxiliaries. 1919.
1544	1000 KW	250# 550° ISP. 2400 volt. NON-CONDENSING @ 50#G. 1925.
1638	1500 KW	250# 550° ISP. 2400 volt. CONDENSING. 1927.
601	2500 KW	250# 550° ISP. 2400 volt. EXTRACTION: 90,000#/hr. Max. @ 15#G. Built 1927. Good condition. Some spare blading.
60	(2) 1000 KW	150# 600° ISP. 480 volt. CONDENSING. All auxiliaries. 1929.
1625	1000 KW	250# 600° ISP. 2400 volt. CONDENSING. All auxiliaries. 1935.
693	2500 KW	250# 650° ISP. 2400 volt. CONDENSING. All auxiliaries. 1934.
1866	1250 KW	400# 650° ISP. 2400 volt. EXTRACTION @ 160#G. (Available with this is a 1000 KW, 160# ISP, 5#G, extraction machine)
1475	4800 KW	600# 750° ISP. 13.8 KV. MAX. THROTTLE FLOW: 95,000#/hr. AUTOMATIC CONTROLLED EXTRACTION: 45,000#/hr. @ 135#G. (Can modify 125# to 150#) and BACK PRESSURE @ 20#G (Can modify 15# to 25#). Minimum to exhaust @ max. extraction: 3000#/hr. Complete except switchgear. New—never installed.

TURBO ONLY

ITEM NO.	QUANTITY & CAPACITY	
953	2000 KW	185# 500° ISP. Non-Condensing @ 40#G. 3600 RPM. 1935. Replaced by extraction machine. Rated 2000 KW maximum.

BOILERS

1864	700 HP	450# 600° FTT. C.E. Co. Chain grate stoker fired. All controls. 60,000#/hr. each.

TRANSFORMERS 1 PH.

794	(3) 2000 KVA	27 KV Primary. 2300 and 480. Rated 1500 KVA at 2300 and 3000 KVA @ 480.
1814	(2) 2000 KVA	23 KV (4-2½% taps above and below) Primary. 2300 Secondary. Less than one year service.

TRANSFORMERS 3 PH.

1856	2500 KVA	13.2 KV Primary. 6.6 KV Secondary (with two 10% taps below).
669	(7) 1000 KVA	11.5 KV Primary. 480 V Secondary. Pyranol filled.
1515	(5) 7500 KVA	33 KV Zig-Zag Primary. 13.8 KV Secondary (Reconnectable to 6.9 KV).

FURNACE TRANSFORMERS

345	4000 KVA	(3 ph) **24 KV (with 2-10% taps below)** Primary. 228/92 (in 12 steps) Secondary. Transformer 5%. Reactor 30% Reactance. Built 1942. Used 2 years.
1521	(6) 3000 KVA	(1 ph) 13.2 KV pri. 240/160 (8 taps) Secondary.
666	(3) 8000 KVA	(3 ph) 11 KV Primary. 100/160 Secondary.
673	1000 KVA	(3 ph) 7.2 KV (with 1-10% tap above and 2 below) Primary. 214/125/94 Secondary. 1934.
694	1200 KVA	(3 ph) 12 KV Pri. 190/87 (8 taps) Secondary. 1931.
350	200 KVA	(3 ph) 230 V. Primary. 120/60 Secondary. New.

MOTOR GENERATOR SETS

607	1000 KW	250 Volt D.C. 2400 volt A.C. 514 RPM.
641	300 KW	250 volt D.C. 2400 volt A.C. 1200 RPM. Rebuilt & guaranteed.
1415	300 KW	250 volt D.C. 480 volt A.C. 1200 RPM. Rebuilt & guaranteed.

ROTARIES

801	(2) 1500 KVA	275 volt D.C. 13.8 KV A.C.
816	2925/3705	222/285 volt D.C. 13.8 KV A.C. Syn. booster.

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UNION TRUST BUILDING • CINCINNATI, 2 OHIO

MAin 5873

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Split Case Double Suction

Cast Iron bronze fitted.

With or without motors

2—14"x12" Dayton Dowd Type CSLH. Capacity 6000 GPM 110' HD 1750 RPM, Serial No. 33199. 200 HP

1—12"x10" Dayton Dowd Type CSLH 3000 GPM 113' HD 1750 RPM. Serial No. 31454

1—6"x5" Dayton Dowd. 1000 GPM. 231' HD. 100 HP Motor.

1—6"x5" Allis Chalmers Type S—1000 GPM 220' HD 100 HP 1750 RPM. All Bronze.

1—5"x6" Gould 500 GPM 1320' HD 4 Stage Fig. 3360 250 HP 3450 RPM

1—4"x4" Gould Fig. 3380, 250 GPM 650' HD 80 HP 3450 RPM

1—2½"x2" Dayton Dowd 4 stage 80 GPM 1050' HD 50 HP 3450 RPM

We carry in stock a complete line of new and rebuilt pumps from ½" to 16". All pumps sold on a rebuilt and guaranteed basis as to condition and performance.

WE SOLICIT YOUR INQUIRIES.

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GEAR TRANSMISSION

300 HP Sturtevant

2515 to 900 RPM Design #3

ELECTRIC APPARATUS REPAIR CO.

1400 No. 6th St., Phila. 22, Pa.

STEEL STORAGE TANKS

2—10,000 Bbl. New Vertical

6—74,000 & 35,000 Bbl. Vertical

8—25,000 Gal. Cap. Horizontal

6—10,000 & 3—20,000 Gal. Horizontal

DARIEN CORP.

60 E. 42nd Street, New York, N. Y.

Quality SINCE 1906 **Wente Motors**

THEIR ELECTRICAL CONSTRUCTION HAS BEEN REBUILT . . . BY EXPERTS

SQUIRREL CAGE

3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	Al. Ch.	I (2200 V.)	900
2	50	Al. Ch.		900
1	60	G.E.	KT	1800
4	60	G.E.	KT (2200 V.)	1200
1	60	Reliance	AA	900
1	100	G.E.	I-16	450
1	100	G.E.	KT (2200 V.)	900
4	100	G.E.	K (TEFCBB)	1200
1	110	G.E.	KTP	1800
1	120	G.E.	FT	3600
2	125	Cr. Wh.	126Q	1450
8	125	Al. Ch.	AR	450
2	150	Al. Ch.		1750
1	250	G.E.	I-17	900
1	250	G.E.	KF (Vert.)	3600

SLIP RING—SYNCHRONOUS

3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	Al. Ch.		520
1	50	Al. Ch.		720
1	50	Ideal	AV	600
1	50	G.E.	I	700
1	60	Ideal	AVX	1200
1	75	West.	CW	400
1	75	G.E.	I	520
2	75	Fair. Morse	BV (2200 V.)	1800
1	100	G.E.	TRB	600
4	100	G.E.	I-16 (2200 V.)	450
1	100	West.	CW (S. P.)	1800

Qu.	HP	Make	Type	Speed
1	100	KW G.E.	ATB (8 PF)	900
1	125	Fair. Morse	T (2400 V.LO PF)	900
1	150	G.E.	TS (8 PF)	1800
1	200	G.E.	TRC (8 PF)	400

D.C.—230 Volt

(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	West.	8K	850
1	50	G.E.	CD 1341	500/2000
3	50	Reliance	T	2700
1	50	West.	8K (115 V.)	500
1	60	West.	8K (115 V.)	500/1500
1	75	Diehl	K11	700
1	90	Cr. Wh.	CMC	225/550
1	100	West.	8K	850
1	100	Cr. Wh.	CM	600
1	150	Cr. Wh.	CMC (550 V.)	1200
1	150	West.	8K	850
1	180	Cr. Wh.	CMC	450

M-G SETS

1— 45 KW West. 60 V DC—440 V AC 1200 RPM
4— 60 KW G.E. 60 V DC—440 V AC 1200 RPM
3— 75 KW El. Mach. 1200 RPM — 230 V DC—440 V AC
2— 75 KW El. Prod. 1200 RPM — 220 V DC—440 V AC
1—100 KW Ridge. — 250/275 V DC—440 V AC
1—105 KW Century 1200 RPM — 70 V DC—440 V AC
1—150 KW G.E. 900 RPM — 250/275 V DC—440 V AC

ALSO—*4000 motors other than listed from 1 HP to 800 HP*

Wente SINCE 1906 *The Wente Electric Co.,*

Hamilton **203 NO. FOURTH ST.** **Phone 4-8128** *Ohio*

POWER EQUIPMENT

INSPECTION INVITED

IMMEDIATE DELIVERY

DIESEL ENGINES

General Motos 900 HP Model 12-567, 2 cy. 12 cyl. 744 RPM with Falk reversing and reduction gear, ratio 2½ to 1. Electric starting. Auxiliaries available.

DIESEL GENERATORS

100 KW DC 240/120 V., 417 Amps., 1200 RPM. Motor: Superior, 150 HP Model GDB-8, 8 cyl., Electric Starting. Auxiliaries Available.

TURBO-GENERATORS

132 KW. AC, GENERAL ELECTRIC, Generator: 450 & 220 V, 3 Phase, 60 cycle, 1200 RPM. 275 Amps. Exciter: 40 KW. DC. 120 V. 22.6 Amps. Reduction Gear: 10071 to 1200 RPM. Turbine: 172 KW. Condensers available.

60 KW. DC. WESTINGHOUSE, Generator: 120 V. 1800 RPM. 500 Amps. Reduction Gear: 7283 to 1800 RPM. Turbine: 60 KW. 89.4 H.P. Condenser available.

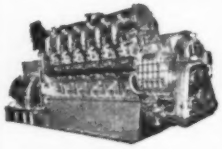
NUMEROUS OTHER ITEMS ARE AVAILABLE FOR INDUSTRIAL USE.

FOR COMPLETE INFORMATION
WRITE PHONE

NORTHERN METAL CO.

MILNOR & BLEIGH STS. —SHIPBREAKERS— PHILA. 35, PA.

PHONE: MAfair 4-1400



DIESEL Generator Plants For Immediate Delivery

1000 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors Model 16-278A.
750 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors Model 12-567.
600 KW, 2400 Volts, 3 Phase, 50 Cycle, 600 RPM, General Motors Model 12-567.
300 KW, 450/2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors Model 8-268A.
200 KW, 450/2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors Model 8-268A.
50 KW, 440 Volts, 3 Phase, 60 Cycle, 900 RPM, Fairbanks-Morse Model 36A 5½.
100 KW, 3 Wire, 125/250 Volts DC, 1200 RPM, General Motors Model 3-268A.
900 HP, General Motors Model 12-567, Propulsion Unit Complete.

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

Tel. NEvada 6-2808 1412-18 So. Alameda Street
Cable Address HEMCOY Compton, Calif.

MOTOR GENERATORS

1—900 KW 440 v d-c, 700 RPM, Al-Ch single B B gen.
540 KW Whse Turbo-Gen 240 v d-c, 200 lbs. non-cond., new 1944
2—90 HP 575 RPM 230 v d-c Whse SK Marine motors w/starters
400 HP 900 RPM 3/60/440 G-E S1 Rg I-M
350 HP 720 RPM 3/60/440 Whse S1 Rg CW
200 HP 1800 RPM 3/60/440 Wagner Sq. C
2—200 HP 900 RPM 3/60/550 (or 440) Whse S1 Rg CW
200 HP 600 RPM 3/60/2200 A-C S1 Rg
2—150 HP 514 RPM 3/60/550 (or 440) West Elec S1 Rg
2—125 HP 900 RPM 3/60/440 Wagner Sq. C
6—333 KVA 13, 200-460/230 Wagner 12 ROC trans 1 ph., 60 cy. O15C
1—667 KVA 4160-2400 G-E trans. 1 ph., 60 cy. PYRANOL 8—7.28% taps

C & S MACHINERY COMPANY
715 Howard St. St. Louis 6, Mo.

TRANSFORMERS

FOR SALE

2—150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6—100 KVA. 60 CY. 1 PH. 2400-240/120.
6— 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. Philadelphia 20, Pa.

FOR SALE

125 HP 150# WP Code Locomotive Boiler
10'x3/16" D&K Power Shear—in use
400 KVA 220/440 V. Gen. D/C Engine
21 Ton S. Tank Locomotive oil-steam
20' (2) Dipping Tanks with Agitators
4" 200 GPM Centrifugal Pumps—NEW

H. & P. MACHINERY CO.
6719 Etzel Ave., St. Louis 14, Mo.

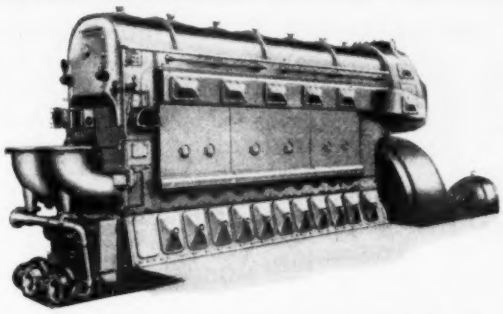
FOR SALE

One 350 HP Model VD-MB 8 cylinder 4 cycle Superior full diesel engine: Fairbanks-Morse diesel units 60 HP up to 600 HP with clutches or generators: Gas engines, high or low speed, with or without generators: Steam engine generating units 75 KW up to 450 KW. Write me your needs.

A. C. ASKEW, Box 3673
Whittier Station, Tulsa 8, Oklahoma. Phone 6-6120

DIESEL ENGINE GENERATORS

Immediate Delivery



2—Fairbanks Morse O. P. MOD 38D8⅛—1600 HP direct connected to Fairbanks Morse 1420 KVA—1136 KW—3 Ph—60 CY—2300/4000 Volt—720 RPM Alternaters with 10 KW direct connected Exciters.

3—Fairbanks Morse O. P. MOD 38D8⅛ 1600 HP direct connected to Crocker Wheeler 1250 KVA—1000 KW—3 PH—60 CY—2300/4000 Volt—720 RPM Alternaters with 10 KW direct connected Exciters.

5—General Motors MOD 3-268A—150 HP, direct connected to Westinghouse 100 KW—3 PH—60 CY—480 Volt—1200 RPM Generators with direct connected Exciters.

2—ALCO (McIntosh & Seymour) 900 HP type 6—12½ x 13—T, direct connected to GE-620 KW, 240 volt D. C. 700 RPM generators with direct connected exciters.

2—General Motors MOD 3-268A—150 HP direct connected to Delco 100 KW—120/240 Volt, 1200 RPM 3 wire DC Generators.

WALTER H. WILMS & COMPANY
2526 GUARDIAN BUILDING DETROIT 26, MICHIGAN
Phone: Woodward 1-1856 and 1-1857

FOR SALE

COMPLETE 2500 KW STEAM POWER PLANT

consisting of two, 1250 KW 3-phase 60-cycle, 2300-volt, Allis-Chalmers turbo-generators with control panels, condenser, boilers, economizers, super-heaters, feed water regulators, pumps, piping, induced-draft fan, direct firing coal pulverizers with bin and stand-by fuel oil burning equipment. All equipment complete with motors and controls where required. In excellent condition and now available.

CONSOLIDATED CEMENT CORP.
111 W. Monroe St. Chicago 3, Ill.

2000 K. W. STEAM POWER PLANT

Complete Power Plant Delivering
6300 Volts 3 Phase
50 CYCLES
With Power Transformers to Step Up and Down 6300/35000 Volts and 6300/400 Volts

Packed for Export in Original Crates

Complete Specifications and Details Upon Request

International Fermont Machinery Co., Inc.
115 BROADWAY NEW YORK 6, N. Y.

FOR SALE

EXCELLENT - - - LOW PRICE

2—30"x42" Corliss Engines, R. H.
2—750 K.W. 250 volt Direct Current Generators. Allis Chalmers Units.

With switchboards and accessories. May be inspected in operation on 155# steam in Long Island City, N. Y. Estimated date for release is late Summer 1949.

Reversing gear on engines makes them available for sugar mills, etc.

HUGH A. BROWN, Agent
235-39 36th Ave., Douglaston, L. I., N. Y.

50,000 lb. Integral Furnace 400 lb. B & W boiler superheater air heater pulverizer fans accessories
2500 KW 2400 volt GE Cond. turbine unit.
1500 KW 480 volt GE NonCond Turbine set.
283 KVA 240 volt Chase Uniflow engine set.
200 KVA 480 volt Ridgway 4 valve engine set.
200 KW G. E. M. G. Set 1200 AC 250 DC.
50 KW G. E. M. G. Set 220/440 AC 250 Dc.

HOWARD B. JOHNSON & ASSOCIATES
53 W. Jackson Blvd. Chicago 4, Ill.

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

Most all units still on foundation. Many may be seen operating

TURBO UNITS (Cond.)
1875 KVA (2) General Electric 2300 v.
1250 KVA (2) General Electric 2300/4150 v.
750 KVA General Electric 2300 v.
750 KVA General Electric 220/480 v.
625 KVA General Electric 2300 v.
375 KVA General Electric 2300 v.

TURBO-UNITS (Non-Cond.)
625 KVA GE 480/240 v., 30/50# BP
625 KVA General Electric 2300 v.
550 KVA A1 Chal-Terry 240/480 v.
375 KVA (2) GE 2300/440/220 v.
250 KVA General Electric 600 v.
62½ KVA, 112 KVA & 125 KVA GE 480/220 v.

DIESEL UNITS
156 KVA Ideal 240/480 v.—Buckeye
125 KVA GE 240/480 v.—Superior
93 KVA GE 480/240 v.—Superior
75 KVA GE 240/480 v.—General Motors
50 KVA FM 240/480 v.—Model 36-A
37 KVA (3) General Motors 240/480 v. (NEW)
Gas Unit—375 KVA GE 480 v.—Cooper Bessemer Gas

BOILERS
605 HP Union 3 drum 200#
507 HP Combustion 400#
488 HP Heine 250#
298 HP Keeler 200#
255 HP B&W 3 drum 200#
220 HP (2) Vogt 3 drum 160#
200 HP Erie City 3 drum 160#
110 HP Erie City 3 drum 180#
280 HP Combustion HRT 150#
106 HP Ames "Economic" 125#
214 HP Kewanee Loco. type 125#

STEAM ENGINE SETS, A.C.
1125 KVA GE-Nordberg Uniflow
625 KVA GE-Nordberg Uniflow
500 KVA GE-Erie Ball 4 valve
312 KVA (2) CW-Skinner Uniflow
312 KVA GE-Chuse 4 valve
187 KVA Wghse.-Ames Unif. (vertical)
187 KVA GE-Chuse 4 valve

STEAM ENGINE SETS, D.C.
600 KW Wghse. 250 v.—Skinner Unif.
200 KW GE 125 v.—Skinner Uniflow
150 KW GE 125 v.—Skinner Uniflow

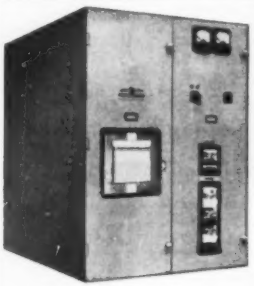
PUMPS — MOTOR DRIVEN

COMPRESSORS — MOTOR DRIVEN

TRANSFORMERS

MOTOR GENERATOR SETS

POWER PLANT EQUIPMENT CO., INC. 39 Cortlandt St. New York, N. Y.



New! GENERAL ELECTRIC
VERTICAL LIFT TYPE M1-6 SWITCHGEAR

9 UNITS incorporating
GE Type FK255-500 . . . 2000 Amp . . 15000 Volt . . 250 Volt DC Solenoid Operated Breakers.

4 UNITS incorporating
GE Type FK255-150 . . . 1200 Amp . . . 15000 Volt . . . 250 Volt DC Solenoid Operated Breakers.

49 UNITS incorporating
GE Type FK255-150 . . . 600 Amp . . . 15000 Volt . . . 125 Volt DC Solenoid Operated Breakers.

for
FEEDERS
INCOMING LINE
GENERATOR CONTROL
INDUCTION MOTOR FULL VOLTAGE STARTING
INDUCTION MOTOR REDUCED VOLTAGE STARTING
SYNCHRONOUS MOTOR LINE STARTING

JOSEPH *Satin* COMPANY
ELECTRICAL EQUIPMENT
1 JORALEMON ST. BROOKLYN 2, N. Y. TRIANGLE 5-0433

FOR QUICK SALE

600 H.P. KEELER BOILER & STOKER

Capacity 25,000 lbs. continuous. 250 W.S.P. Only 6 years old, has had best of care. Accessories include Bailey Flow Meter, Copes Speedwater Regulator, forced draft fan and motors plus $2000 worth of stoker and boiler parts. Price $10,000. Located in Cleveland. Write J. R. Rundle, 428 Cleveland Rd., Cleveland 8, Ohio.

FOR SALE

1000 KW Westinghouse Turbine; 3 ph-60 cy-2300 volt; 180# Steam pressure; 50° Superheat; straight condensing. Worthington vacuum pump included. Available immediately.

Ingersoll-Rand Class PRE 25x15 ¾x18 air compressor; 270 HP synchronous motor; 3 ph-60 cy-440 volts. Complete with starting gear exciter and spare parts. Tip-top shape. *Available immediately.*

EVANS PRODUCTS COMPANY
Western Division, Coos Bay, Oregon

TRANSFORMERS

3—150 KVA, 2400 volts primary to 230/460 volts secondary, 60 cycle, 1-phase, Moloney, *new.*
3—150 KVA, 13,800 volts primary to 130/260 volts secondary, 60 cycle, 1-phase, Wagner late model, steel case.
3—667 KVA, 13,800 volts primary to 230/460 volts secondary, 60 cycle, 1-phase, Wagner late model, steel case.
1—100 KVA, 33,000 volts primary to 2300/4160 volts secondary, 60 cycle, 1-phase, General Electric, type "H", Form K.D., steel case.
1—37½ KVA, 4000 volts primary to 115/230 volts secondary, 60 cycle, 1-phase, General Electric, type "H", Form K, steel case.
1—10 KVA, 6,600 volts primary to 110/220 volts secondary, 60 cycle, 3-phase, Moloney, Type "F", C.I. case.
1—100 KVA, 6900 volts primary to 115/230 volts secondary, 60 cycle, 1-phase, General Electric, Type "H", Form KR, steel case.

All in Stock for Prompt Shipment. Will Be Overhauled and Guaranteed.

INDEPENDENT ELECTRIC MACHINERY COMPANY
300 Southwest Boulevard Kansas City, Missouri

Nordberg 1250 HP diesel elec. generating units.
Power Plant, steam turbo-electric, 1500 KW.
Fairbanks-Morse diesel engine, 805 HP, 300 rpm.
Whirley gantry crane, elec., 120' boom, 37 tons.
C.P.T. air compressor, 1574' diesel.
Whitcomb 7-ton gas locomotive, 36" ga., rebuilt
Locomotives, diesel, gas, steam, 5-80 tons.
Guiberson diesel engines, 200 HP, 9-cyl.
Shovels—Cranes—Draglines, ½-yd. to 5-yd.
H. Y. SMITH CO., 828 N. B'way, Milw. 2, Wis.

CONSULT US FOR
Diesel Gasoline and Steam Generators, Electrical and Industrial Equipment
POWERITE CORPORATION
140 Cedar St. New York 6, N. Y.
DEPT. 185 BA 7-8199

FOR SALE
2—Used 300 H.P. Boilers complete with steel stack, breeching, stokers, feed water pump and heater. Immediate delivery F.O.B. cars on acceptable bid.
MIDWEST MFG. COMPANY
Galesburg, Illinois

FOR SALE
One 1,000 KW G.E. turbo unit incl. condenser, auxiliaries, foundation plans—being replaced by larger unit.
750 KW Whse. turbo unit
Two 2000 gpm motor-driven pumps
10,000 #/hr. Deaerating Heater
ROOM 4200, 141 W. JACKSON BLVD.
CHICAGO, ILL.

SEARCHLIGHT SECTION

SLIP RING MOTORS
3-Ph., 60 Cy.

HP	Volts	Make	Speed
450	440/220	Whse.	514
300	440/220	G.E. MTC	600
200	440/220	G.E.	900
200	2200/440	G.E.	600
200	2200/440	G.E.	1200
200	440	G.E.	450
150	440/220	Whse. (2)	1800
150	2200/440	G.E.	1200
150	440/220	G.E.	720
125	2200/440	G.E.	600
125	440/220	G. E.	900
100 (2)	440/220	Whse.	900
100	2200/550	G.E.	1800
80	440/220	G.E. (MTC)	900
75	2200/550	G.E.	1800
75	440/220	Whse. 25 cy.	750

SYNCHRONOUS MOTORS
3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
240	440/220	Whse.	G	1800
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

GENERATOR SETS

1—62½ kva. 1200 rpm, 220 volt, Whse., geared to 7300 rpm, Whse., non-cond. steam turbine, 150 lbs. pr.
2—unused 25 kva, 120/208 v., 3 ph., 1200 rpm, generator dir. conn. to Waukesha 6 cyl. gas engine

AIR COMPRESSOR UNIT

1—13" and 8" by 10" Worthington FEATHER-VALVE, 285 rpm. 110 lbs. ga. motor-driven.

CIRCUIT BREAKERS

2—2000 amp., GG E. 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse. 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	900
400	550	G.E.	IK	720
300	2200/550	Whse.	CS	1800
300	440/220	G. E.	KT	900
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brs.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G. E.	IK	514
125	440/220(2)	G. E.	IK	514
125 vert.	440/220	G.E.	KTP	1200
100	550	Cr. Wh.	Q	900
100	2200/440	G.E.	K	1200
60	440/220 (new)	I. Allis	OGA	1800

A. C. GENERATORS

1—320 kva., 600 rpm., 440/220 v., G.E.
1—225 kva., 600 rpm., 220/440 v., G.E.
1—150 kva., 1800 rpm., 2200/550 v., Whse.
1—112 kva., 900 rpm., 440/220 v., G.E.
1— 98 kva., 1800 rpm., 440/220 v., G.E.
2— 75 kva., 1800 rpm., 440/220 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
350	230 (2)	G. E.	CD	1150
200	230	Cr. Wh.	CMC	890
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230 (new)	Whse.	SK	1150
75	230	Whse.	SK	850
75	230	Whse.	SK	1750

MOTOR GENERATOR SETS

1—165 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm, 440/220 v., squirrel cage
1—150 kw, 900 rpm, 240 v., Cr. Wh., conn. to 225 hp, 900 rpm, 2200/550 v., squirrel cage.
1—125 kw, 1200 rpm, 250/120 v., G.E., conn. to 175 hp, 1200 rpm, 4000/2300/440 v., synchronous
1—75 kw., 125 v., 1200 rpm., G.E. conn. to 120 hp., 2200/440 v., syn. motor.
1—50 kw., 250/1200 rpm., G.E. conn. to 75 hp., 440/220 v., 60 cy., G.E. syn. motor.
1—50 kw., 250/1200 rpm., G.E. conn. to 75 hp., 440/220 v., 60 cy., syn. motor.

TRANSFORMERS
60 Cy.

1—1000 kva., Al. Chal. 2400-120/240/208 volts, 3 ph.
1— 400 kva., G.E. 2300-230/115 v.
3— 300 kva., G.E., 13800/6900-115/230/460 v.
3— 200 kva., Moloney, 2400-240/480 v.
2— 150 kva., G.E., 13800/6900-110/220 v.
1— 150 kva., Whse. SK, 13200-125/215 v., 3 ph
3— 150 kva., G. E., 2300—230/460 volts
6— 100 kva., G.E., 4600/2300-230/115. NEW
3— 100 kva., G.E., 450-115/230 v., dry, 1 ph., new
5— 75 kva., G.E., 2400-240/120 v.
3— 75 kva., G.E., H-KF, 2300-230/460 v.

STEPHEN HALL & CO.
HARRY J. RICE PRES.
458 SEVENTH ST. HOBOKEN, N. J.

FOR SALE

4—ROTARY CONVERTERS:

Synchronous Converters	Serial Numbers
General Electric	
Type HCC 6 1500 500	3940449
Form J	3940450
Cycle 25	5940451
Speed 500	4099467
Direct Current	
Amp. 2500 nominal	
Volts 600	
3750 amp. 2 hrs. 55° C. rise.	

2—INGERSOLL-RAND CAMERON PUMP DIVISION CENTRIFUGAL HYDRAULIC PUMPS:

1—Size 5 CT-6 Serial A412011
GPM 865 Head ft. 1190
RPM 1450 Hyd. Test 1500
Year Built October 1941.

1—Size 5 HST-5 Serial 06443253
GPM 865 Head ft. 1120
RPM 1450 Hyd. Test 1500
Year Built June 1944.

1—G.E. INDUCTION MOTOR:
Model 23E949 Phase 3
Type KT Cycle 25
Volts 6600 Speed, full load 1475
F.L. amp. 53 700 HP continuous 40° C. rise Serial 4228896
Year Built 1923

CLEVELAND IRON & METAL CO.
2432 West Third St. Cleveland 13, Ohio

DIESELS

Two (2)—900 H.P. at 700 RPM. Mfr.—Maschinen Fabrik Augsburg—Nurnberg (M.A.N.) Complete with Auxiliary Equipment.

DIESEL-GENERATORS

Twelve (12)—12.5 KVA 230/400 volts — 50 cycle International Harvester—Marble Card.

One (1)—100 KW D.C. 230 Volt—423 Amp. at 900 RPM 230 Volt—350 Amp. at 750 RPM. M.A.N. Diesel—6 cylinder.

TURBO-GENERATORS

Four (4)—250 KW A.C. plus 40 KW D.C. 250/450 V 3 phase, 60 cycle or 200 KW plus 30 KW D.C. 220/380 V—50 cycle Mfg. by General Electric Co.

Two (2)—300 KW D.C. 120/240 volt 6 Pole—3 wire—Comp. Wound Turbine by Worthington Moore. Generator — Allis Chalmers.

Two (2)—300 KW D.C. 120/240 volts. Comp. Wound Turbine by J. Hendy. Generator—Westinghouse.

This Equipment in Original Crates

INTERNATIONAL FERMONT MACHINERY CO., INC.
115 BROADWAY NEW YORK 6, N. Y.

FOR SALE

One Worthington, single horizontal tandem three stage air compressor, serial No. L-43438. Purchased 1941. Size 10/6—1¼/2—3¼x11. Equipped with lubrication and air filter. First stage 100 psi. Second stage 350 psi. Third stage 1200 psi. Price $5500.00, FOB Barberton Plant loaded on flat cars. Condition good. No performance or other guarantee. For inspection contact Purchasing Dept., Pittsburgh Plate Glass Company.

COLUMBIA CHEMICAL DIVISION
BARBERTON, OHIO

APRIL OFFERINGS

1—B & W—Water Tube Boiler 200# P.S.I. A.S.M.E.—Natl. Board—400 H.P.
2—Heine-Water Tube Boilers—225# P.S.I. Cross Drum—Steel Cased—3½" tubes—Retubed 1943
1—Erie City—3 Drum Water Tube—1934 275# P.S.I.
Also New Package Units—30—300 HP—15#—100#—125#—150#

HOWE BROTHERS
342 MADISON AVENUE NEW YORK 17, N. Y.
Tel. Nos. MU. 2-8562—8563—8564

Dependable Power Quickly Available

TWO NORDBERG DIESEL GENERATING UNITS

1250 H.P. — 1060 KVA Heavy Duty — Low Speed

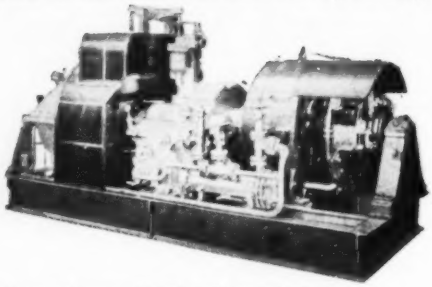
These engines are moderately priced, guaranteed by America's foremost builder of large Diesels and given Nordberg inspection and reconditioning with generous parts replacements.

Save money by installing an engine of rugged construction, one that burns cheapest low grade fuels. Available because of being replaced by larger Nordberg Diesels.

Wire or write T. C. Wiedenhoefer for particulars

NORDBERG MFG. COMPANY, Milwaukee, Wis.

NEW WESTINGHOUSE 300 KW 120/240 Volt DC Turbo-Generators, ABS & Lloyds approved.



TURBINE—Westinghouse 440 PSI, 740° F., 28.5" vac.

REDUCTION GEAR—Westinghouse 5930/1200.

GENERATOR—Westinghouse, Stab. Shunt Wound 300 KW, 120/240 FLV, 1200 AMP, 1200 RPM, cont. 40° C., 25% overload 2 Hrs. 55° C.

WAREHOUSE STOCK—Marine Machinery, Deck Machinery, Diesel Engines, Generators, Motors, Pumps.

ATLAS MARITIME CORPORATION

39 Broadway, New York 6, N. Y. Cables—ATGINEER Tel. Digby 4-4990

INGERSOLL-RAND DIESELS SKINNER UNIFLOW ENGINES

For generating, pumping or compressors

1—385 HP type S diesel, 600 RPM 10½" bore 12" stroke, coupled to G. E. 250 KW 125/250V D. C. generator.

1—255 HP type S diesel, 600 RPM 10½" bore 12" stroke, coupled to G. E. 150 KW 125/250V D. C. generator.

2-400 HP Uniflows, 200 RPM 22" bore 24" stroke, coupled to G. E. 250 KW 125/250V D. C. generators.

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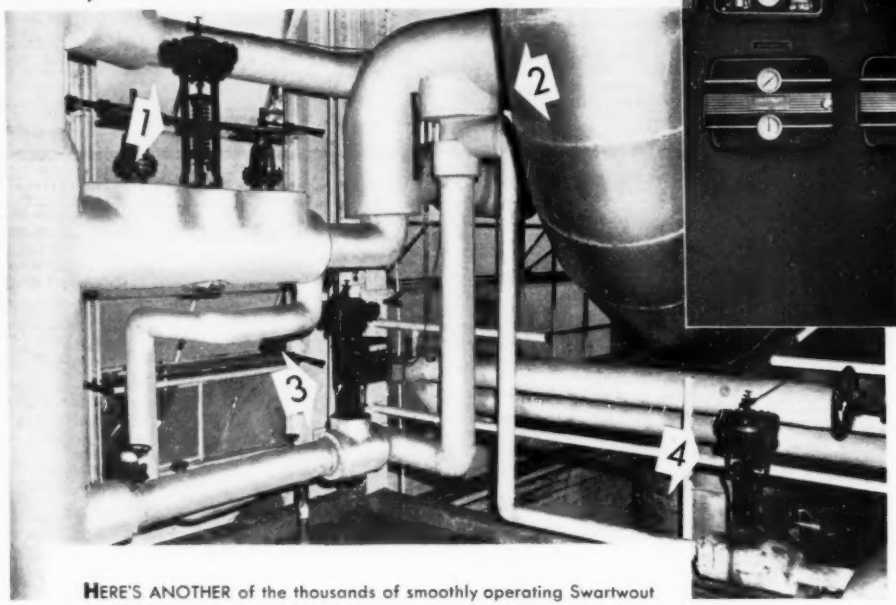

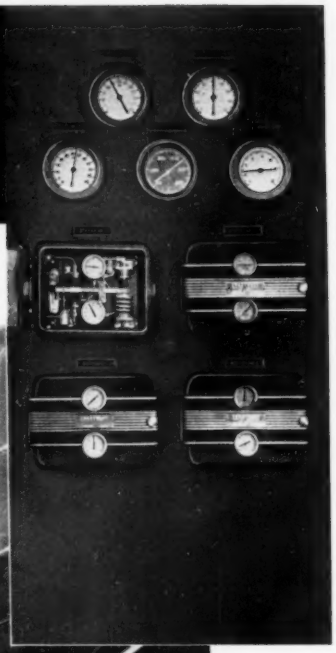

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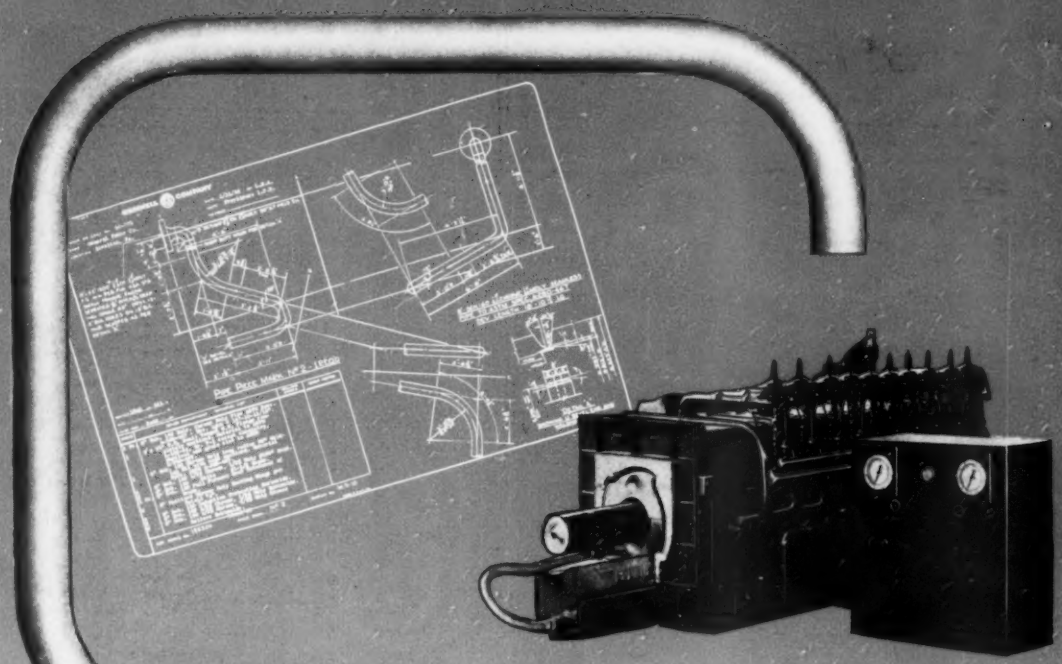

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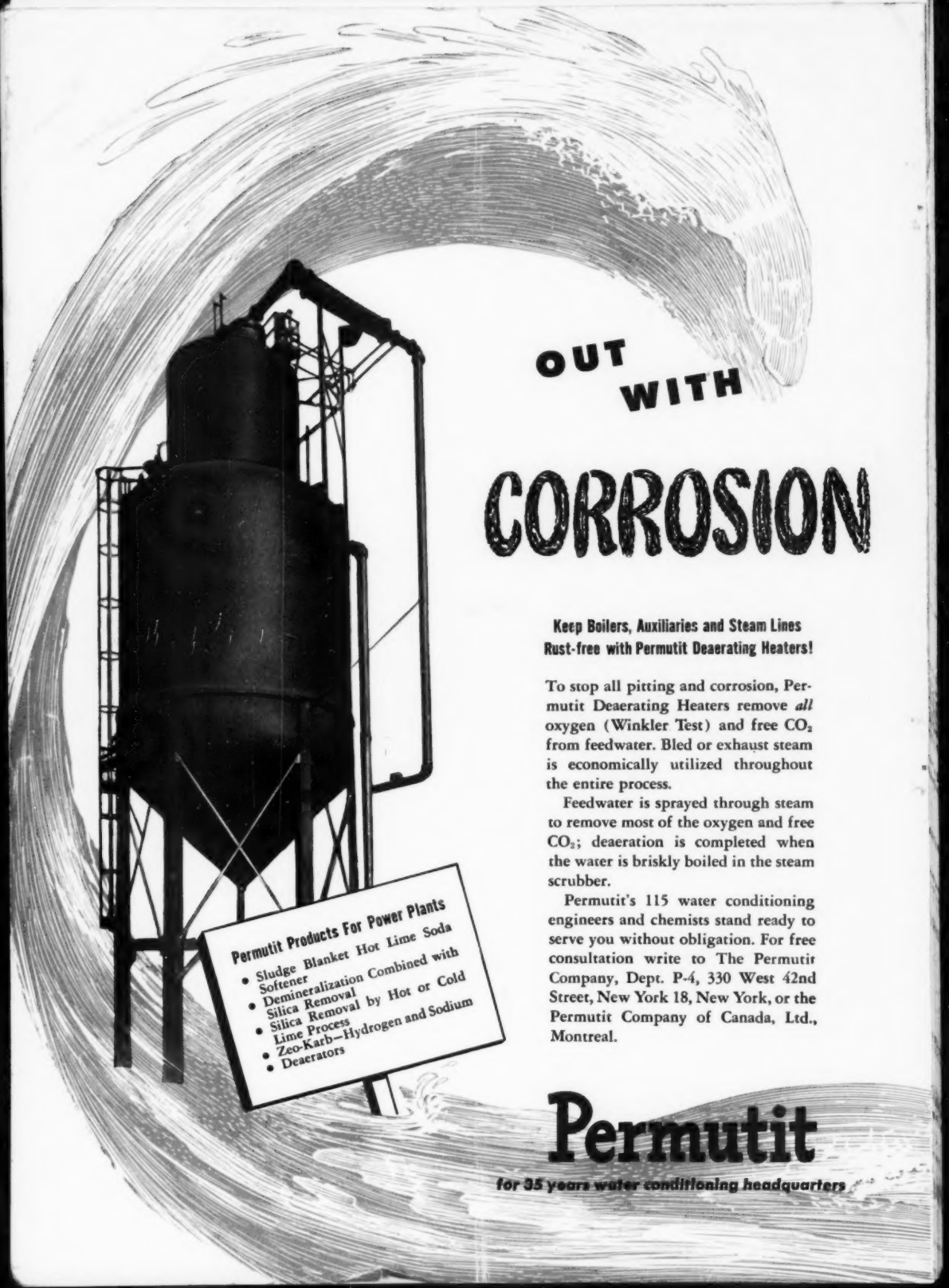
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Permutit

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